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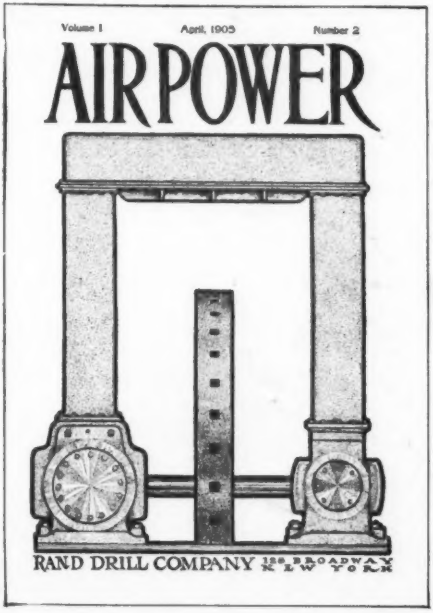
VOL. X. NEW YORK, MAY, 1905. No. 3.



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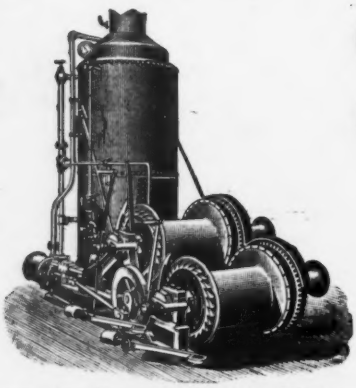

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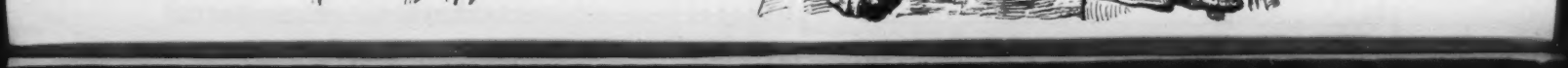

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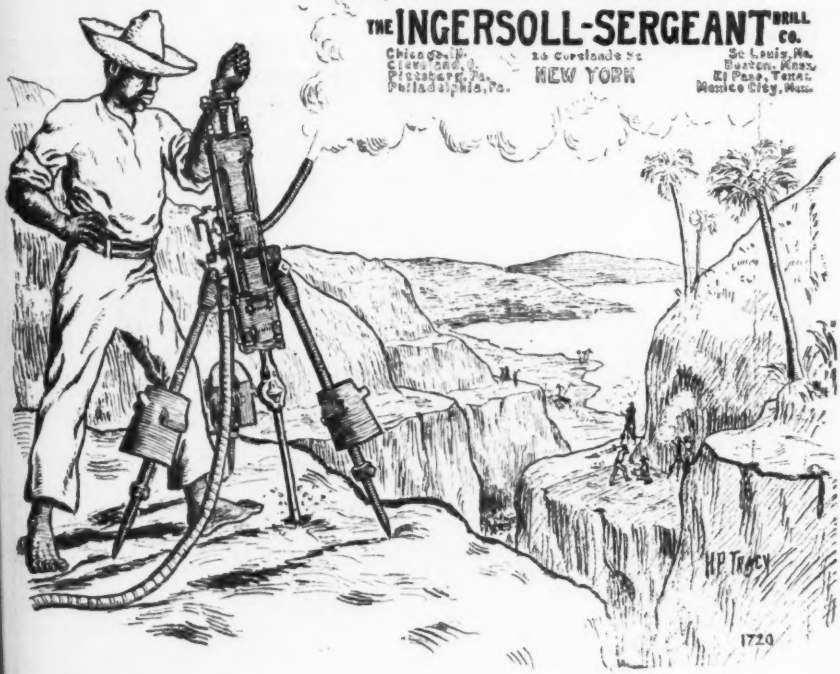

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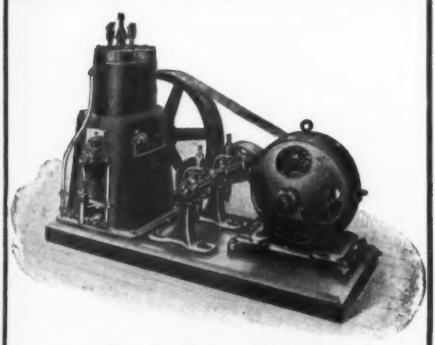

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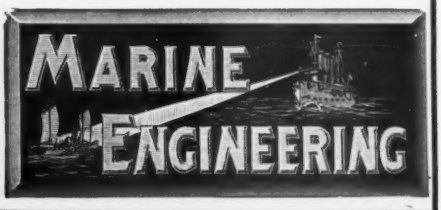

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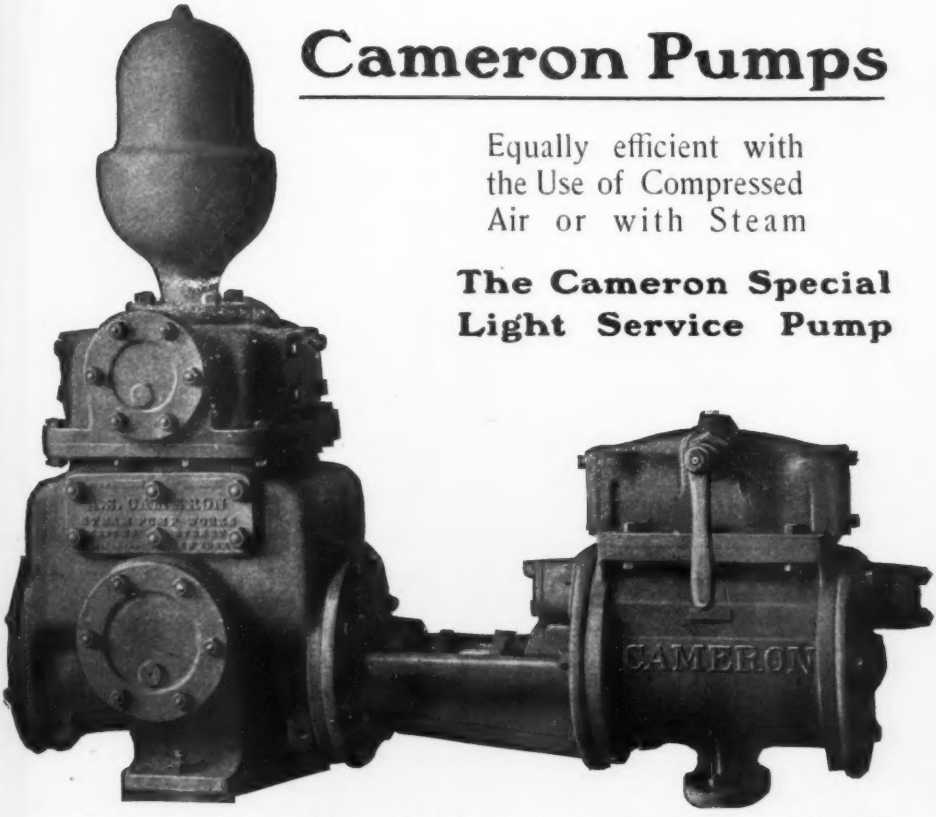

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The Panama Canal.

There are few manufacturers of machinery that are not more or less directly interested in the mammoth undertaking on the Panama Isthmus which the United States Government has assumed. There are a multitude of tasks to be performed which will require the united services of all methods of power transmission. Compressed air will figure most prominently in the work of rock excavation. Whatever the decision of the Commission as to the level of the canal, there are many thousands of cubic feet of rock which must be removed. Modern methods will be adapted to the special requirements. Modern machinery will be installed and every advantage taken of the latest economic practices. There have been many undertakings which have required the excavation of large quantities of rock, but never under exactly similar conditions. New problems will arise for both the manufacturer of machinery and the engineer to solve.

The digging of the Chicago Drainage Canal was an enterprise of the same general character, although on a much smaller scale. It developed some mechanical devices which overcome supposedly unsurmountable obstacles. The lessons of that undertaking have been guides to many in subsequent tasks. The digging of the Panama Canal promises to throw still greater light on the problem of the economical excavation of rock. The greatest possible economies must be secured. Even with modern methods the cost is going to be enormous. The careless methods of many contractors, to whom speed is the only consideration, will be supplanted by a combination of efficiency and rapidity of operation. This will require machinery that will combine reliability and economy. Already part of the necessary equipment has been purchased, but there is still much more to be selected. The development of new devices and the adapting of the old will mark an important epoch for the manufacturers of compressed air machinery.

A Remarkable Accident.

Probably every reader of COMPRESSED AIR has heard of the remarkable accident in which one of the workers in the Subway tunnel under the East River, N. Y., was blown through the river bottom, the river itself and projected into the air above without suffering bodily injury. In stopping a leak of air from the heading he was caught by the air and carried out with it. The facts concerning this accident, as given by the *Engineering News*, are published in the "Notes" at the back of this number.

This accident did not demonstrate any new principle, but it did strikingly illustrate the power of compressed air. The air pressure in the heading at the time of

the accident was only 16 pounds to the square inch above atmospheric pressure. There was a distance of 5 feet of mud and 15 feet of water above the tunnel. Richard Cregan was blown through mud and water with practically no bodily injury save the shock of such a unique experience. The thought of the air itself penetrating through mud and water is not unusual. When the size of the opening required and the weight of the man is considered, Cregan's experience demonstrates what a great power was at work.

Air Brakes in City Service.

Several questions confront the management when considering the use of air: Are the cars worth the additional expense? for air brakes are undoubtedly expensive. What advantages will they gain by their use? What will be the cost of maintenance?

The first question, says Mr. Edward C. Boynton, in the *Street Railway Journal*, is not very difficult to answer. All large systems are continually buying new cars, and it is needless to say that the oldest cars are probably not worth the expense. As to the second question, there seem to be three advantages gained over the hand brake, viz.: The ability to maintain a faster schedule; the decrease in accidents due to the emergency stop, and the slight economy in power consumed by the car.

Several competitive tests against the hand-braked car have proved this, but as the saving is so slight it is only necessary to convince the management that more power is not being used to drive the independent motor compressor than was used before.

In regard to the ability to maintain a faster schedule, in city as well as interurban service, it is well known that acceleration plays a most important part, but acceleration is both positive and negative, and they are equally important. The time has come when the amount of acceleration, either positive or negative, must be limited by the comfort of the passengers. This renders necessary a uniformly accelerated start and stop, as near as it is possible to secure it.

The modern car controller aims to make the positive acceleration as uniform as possible, though, to a large extent, it is still dependent upon the skill of the motorman, as is also the negative acceleration in stopping with the air brake. An acceleration both positive and negative of 2 miles per hour per second can be obtained in a modern car equipped with air brakes without discomfort if fairly uniform. The resulting increase in schedule speed even in city service under the above conditions is remarkable.

The emergency stop with the air-braked car, while it may nearly cause the passengers to "change seats," has undoubtedly been the means of preventing some loss of life as well as the saving of thousands of dollars in damage to equipment. Almost every road which has used air brakes for the past few years can testify to the truth of this statement, and many cases have occurred under the writer's personal observation.

The cost of maintaining an air-brake equipment varies in about the same proportion as the cost of maintaining the motive power of the car. It depends entirely upon the existing conditions on the different roads.

These conditions mean not only the physical characteristics of the road as regards grades, etc., but also on the kind of care and inspection the equipment receives from those immediately in charge. In this last condition lies the whole secret of the cost of maintenance. Rigid inspection daily of the air-brake equipment is as necessary as the inspection of the motors and controllers.

In nine cases out of ten the failure of an air brake is due to such trifles as a worn-out carbon brush in the motor compressor or some disarrangement of the connections to the automatic governor, which can be repaired in less than five minutes, and are nearly always due to careless inspection, or, more often, to no inspection at all.—*The Engineering Times* (Eng.).

The Pneumatic Tube System of St. Louis.

For several years the Post Office Department has had pneumatic tube service in Boston, New York and Philadelphia. This service proved so satisfactory that two years ago, after thorough investigation and an exhaustive report by a board of experts, it was decided to extend the service in these cities and to equip St.

Louis and Chicago with similar systems. Bids were opened August 15, 1902, and the contract for St. Louis was awarded to the St. Louis Pneumatic Tube Company, of that city. This company adopted the system of the American Pneumatic Service Company, of Boston. As soon as the franchise could be obtained work was commenced. Owing to the various delays incident to obtaining the necessary franchise from the St. Louis city government, the work of construction was not commenced until September, 1903. On June 30, 1904, the first section of the line was opened.

The system is in two sections, both starting from the general Post Office, one running west to the Union Station, the other running east to a new postal station which has been erected at the east end of the Eads Bridge, at the corner of Third and Washington streets. The tubes of the first section are laid under ground along Ninth street to Pine and down Pine street to Nineteenth street, through Nineteenth street to the Union Station and then across the station under the tracks to the new post office annex. The terminal machinery is located at the main floor of the general post office and on the second floor of the annex.

The tube used is cast-iron pipe bored out to a diameter of 8.125 inches. In boring, a variation was allowed the contractors of .016 of an inch; that is, the minimum bore was 8.125, and the maximum was 8.141. The bends are made of brass 8⅜ inches inside diameter, bent to a radius of 8 feet. These bends were flanged on the ends and connected to the line of pipe by special castings with a taper bore. The joints were made in the same manner as ordinary water or gas pipe with yarn and lead. Before back-filling, every joint was tested by compressed air at a pressure of 25 pounds.

In laying the tube the street was opened in the usual manner and two pipes laid side by side with the bells facing in opposite directions. The line was laid so that the carrier passed from the spigot end of one pipe into the bell end of the other. The pipe used being of a special pattern, had a reinforcement back of the bell to take any shock when the carrier passed the joint. After the pipe was laid in position and before the joint was made, an iron mandrel was passed through the joint in order to be sure that it was perfectly smooth and that the deflection was not excessive. A deflection of 1½ inches in a 12-foot pipe was the maximum allowed. As this deflection is much less than that used in ordinary pipe laying, it was found necessary to go considerably deeper than is generally the case. For instance, in making the crossing of Olive street, at the corner of Ninth, where the pipe had to be 9 feet under the pavement in order to avoid other obstructions, the pipe had to begin to pitch downward at Pine street on the south and at Locust street on the north. This rendered it necessary to have a great deal of trench open at one time in order to give the engineer in charge time to see what he was running into. At the crossing under the railroad tracks extra precautions had to be taken to prevent the vibration of the trains working the joints and causing them to leak. On each side of the trench a 12 by 12 inch post was set with a footing block about 18 inches below the bottom of the pipe. A cap was put across these two posts and carried the ties which brought the vibration down underneath the pipe. So far no leaks have appeared and the line is perfectly tight. At the Post Office annex the authorities required that the terminal machinery be set on the second floor. This is at an elevation of about 25 feet above the level of the tubes under the tracks. This difficulty was overcome by entering the annex at the north end, putting offset bends around the elevator shaft and rising on an incline of 30 degrees. The carriers mount this inclination without any trouble or perceptible slacking of speed.

The system used is continuous current pressure, the compressors being located in the basement of the general Post Office, taking steam from the boilers of the Treasury Department. Two compressors have been installed, one, furnished by the Rand Drill Company, is a cross compound duplex air with steam cylinders 10 inches and 18 inches by 20 inches, and air cylinders 26 inches by 20 inches. The steam end has a regular Corliss valve gear, while the air end has Corliss inlet and outlet valves worked directly from eccentrics on main shaft.

The second compressor of similar type was furnished by the Laidlaw Dunn Gordon Company, the stroke being 24 inches and the steam cylinders 11 inches and 18 inches and the air cylinder 24 inches in

diameter. The Corliss valves on the inlet of the air cylinders are worked directly from an eccentric on the main shaft, but the outlet valves are worked from a swing plate instead of directly. The line requires 1,550 cubic feet of free air compressed and delivered per minute. The normal pressure on the line is about 9 pounds. This gives a carrier a velocity of 50 feet per second or a trifle more than 30 miles an hour. Both compressors are connected to a large tank into which the air returns after having made the circuit from the Post Office to Union Station. This tank also has an outlet outside of the building so that fresh air can be taken in to supply that which is lost in operating the terminals. Except for this the same air is used over and over again, by which means a large amount of condensation is avoided. Each compressor is provided with an after-cooler, which is similar in construction to the re-heaters and inter-coolers so familiar in compressed air work. They consist of a nest of pipe in a long tank which is placed directly over and connected to the air cylinders of the compressor. A water connection is made so that cold water is flowing through the small pipes and the hot air leaving the compressor is cooled and a considerable part of its moisture thrown down. These after-coolers have worked very satisfactorily since their installation.

There are three styles of terminal machines in use, the transmitters or sending machines being alike at both ends of the line. These transmitters are of a new design known as the gravity type. They consist of two gates hung on pivots and separated by a chamber 24 inches long, or the length of a carrier. This chamber is set on an incline of 45 degrees and just beyond the lower gate is a grated tee which is connected directly with the compressor and through which the air flows into the line. There is a small connection between the tee and the central chamber. When a carrier is to be dispatched it is placed on a scoop just above the upper gate and its weight permits it to slide down and strike a finger which opens a spill valve and allows the pressure of the air in the central chamber to be reduced to atmosphere. The weight of the carrier pushes the upper gate out of the way and the carrier falls into the central chamber. The upper gate is balanced so that it closes by its own weight and the chamber filling with air at the line pressure the weight of the carrier pushes the lower gate out of the way, and the carrier falls into the current of air and is carried along.

In order to prevent the carriers being despatched too rapidly a time lock is attached to the scoop. This time lock consists of a cylinder with a piston running into it. This piston has holes bored in it and has a clapper similar to that in the old-fashioned pump. The piston is connected to a larger piston in another cylinder which has air pressure from the central chamber on the upper side. This pressure normally holds the piston down against the spring. When the pressure is relieved by the opening of the spill valve, the spring forces the whole combination up and locks a finger which is in the scoop directly in the path of the carrier. When the pressure is restored it forces the piston down, but the lower cylinder is filled with oil which cannot get back through the pump valve and is obliged to flow around through a by-pass. The opening in this by-pass can be more or less closed by a needle valve, and by regulating the size of the opening the length of time during which the finger is locked in place can be adjusted to suit the circumstances. The usual spacing is 10 seconds between carriers, as this is as rapid as the average man cares to handle them.

At the annex the receiving machine is of a new type which was developed for use in Boston. It is known as a two-gate receiver and works on the principle of an air lock. There is a central receiving chamber closed by a revolving valve at each end. These valves are connected to a single cylinder by a modification of the well-known Geneva stop. This stop is set so that one valve only can be opened at a time. Between the line and the receiving chamber there is a grated tee similar to that used on the transmitter.

The current of air comes through the line, passes down through the grated tee and across to the transmitter for the return. The machine is normally set so that the valve towards the line is open. When a carrier comes in it passes over the grated tee and into the receiving chamber. An air cushion forms in front, which brings the carrier to rest. This cushion is taken advantage of to move

an auxiliary valve which controls the main valve on the cylinder. As the carrier comes to rest the main valve on the cylinder is thrown over and the position of the gates is changed so that the one farthest from the line is opened. A small by-pass around the first valve permits enough air to get behind the carrier to drive it out on the table. As it passes out it trips a finger which changes the auxiliary valve and causes the machine to return to normal position. This operation takes about 2½ seconds.

The receiving terminal at the post office has only one gate, which closes off the end of the line about 4 feet beyond the grated tee which returns the air to the tank previously mentioned. As the pressure at this point has reduced to only about 2 ounces, no air lock is necessary. The single gate is operated in the same manner as the two-gate machine at the annex.

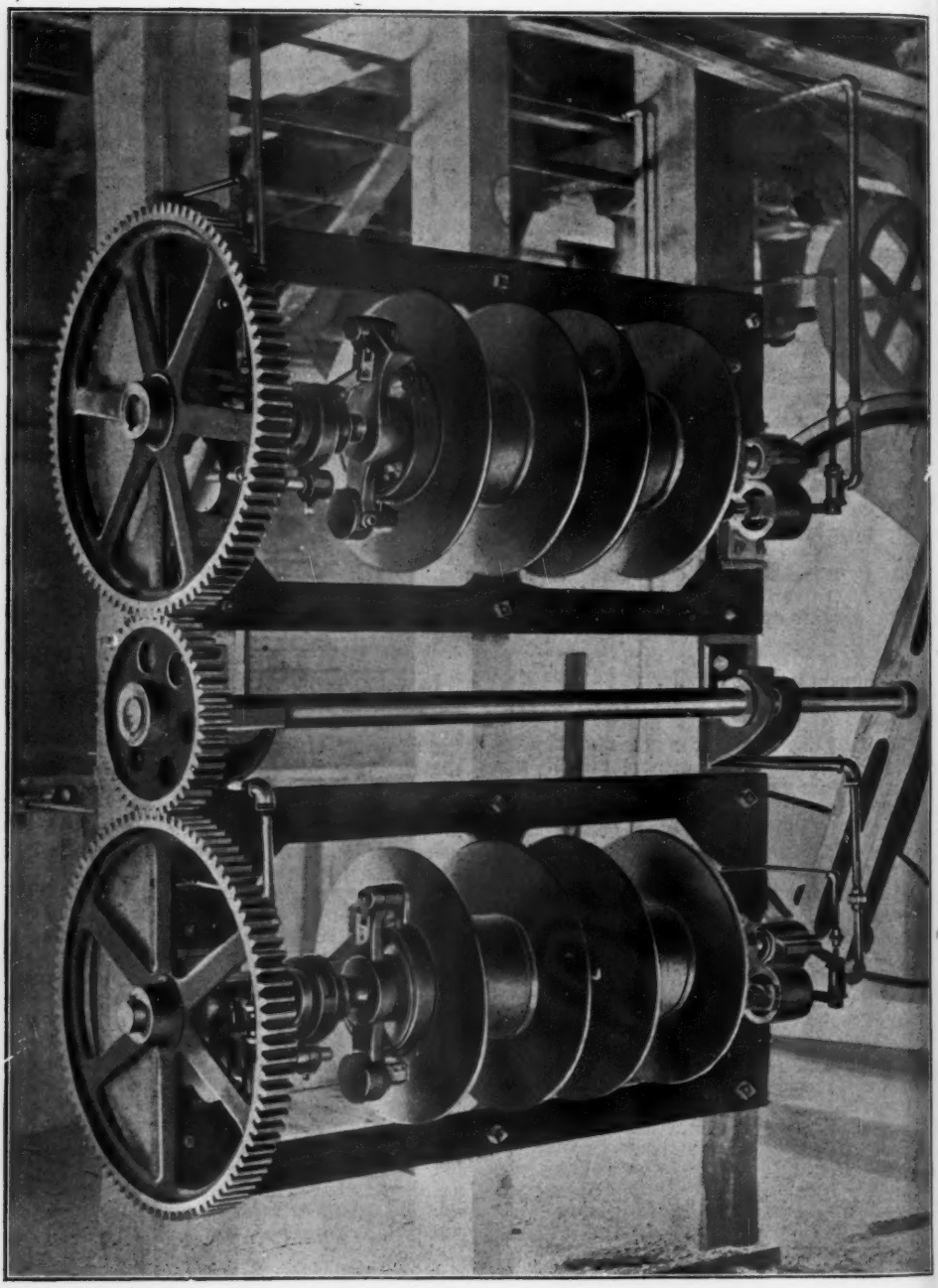
The carriers used are made of sheet steel, 7 inches inside diameter and 24 inches long. Bearing rings are placed about 3 inches from each end. At one end of the carrier is a buffer made of felt. The carrier opens at the other end with a dish lid held in place by three fingers, which are worked by rack and pinion motion on a short handle.

The operation of the system has been very satisfactory from the very outset. The first day that it was put into practical service a striking demonstration was made of its usefulness. A special delivery letter for the city of New Orleans was mailed about 10 minutes before train time. It was brought over to the depot about 5 minutes before the train was due to pull out of the Union Station. It occurred to the clerk in charge that perhaps connection might be made so a carrier was despatched containing this one letter. On its arrival at the Union Station another clerk took it and running out easily caught the train and started the letter on its way some 8 hours sooner than it otherwise would have been sent. Since then quite a number of similar connections have been made. The time of closing the mails at the post office has been placed forward about 20 minutes. One of the great factors in the usefulness of the tube is the fact that the mail is brought directly under the working floor of the post office instead of into a basement or an outside room. It takes no longer to carry the mail over to the annex than it formerly did to carry it the same distance and load it onto the wagons, while under the new conditions the mail is brought directly onto the tables of the clerks at the general post office instead of having to be trucked through from an outside point as formerly. It is hoped that conditions will be such that the service can be extended across the river to a relay depot at East St. Louis. The contract as originally signed provided that the tubes should be laid across the East Bridge, but owing to the necessary repairs incident to the World's Fair traffic, and since the opening of the Fair traffic itself, it has been impossible to lay the tubes. When the service is in operation across the bridge it will be possible to mail a letter at the post office for a train going east after the train has left the Union Station and have it catch the mail at the relay depot. Coming from the other direction the mail will be in the post office before the train which brought it has reached the Union Station.

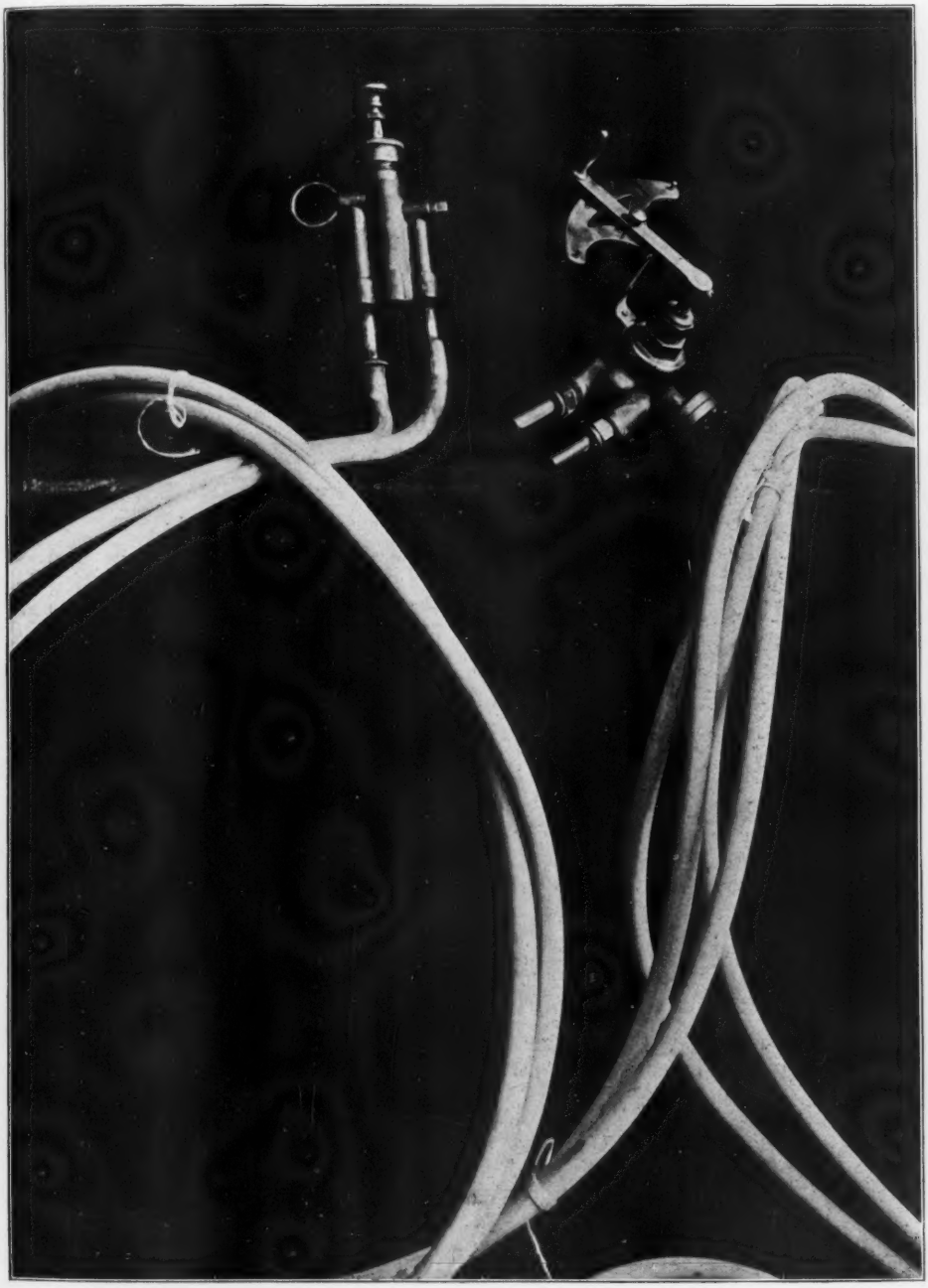
EDWARD D. SABINE.

Compressed Air Grain Shovels

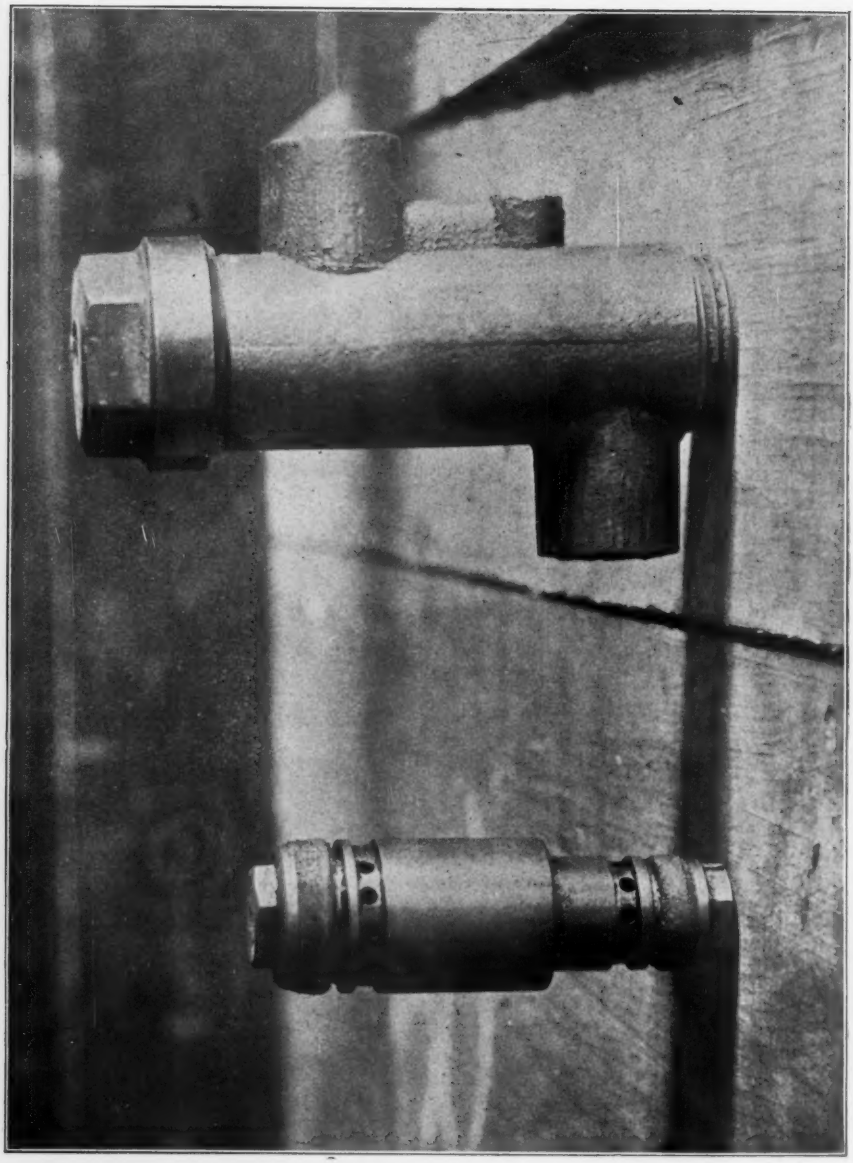
In using compressed air for shoveling purposes it is but using this agent in just the reverse order which it is used for applying brakes to railroad cars. In the one case it is used for the purpose of retarding the motion of a revolving wheel, in the other for carrying motion or revolving a rope-winding drum. In using air for grain shoveling purposes the friction drums are located in the elevator tower as a permanent fixture and removed at some distance from the hold of the vessel or from the place the shovels are being used. It is, therefore, necessary to obtain the following results by the use of this agent: First—Promptness in starting, and necessarily in stopping the shovel. Second—The operating means to be flexible so that the control can always be under the "thumb" of the man tending the shovel (who walks directly behind it). Third—Simple, uncomplicated machinery that an average laborer will understand quickly. Fourth—Different parts so arranged to be always accessible and always to be strong enough to withstand the wear and tear of this rough work.



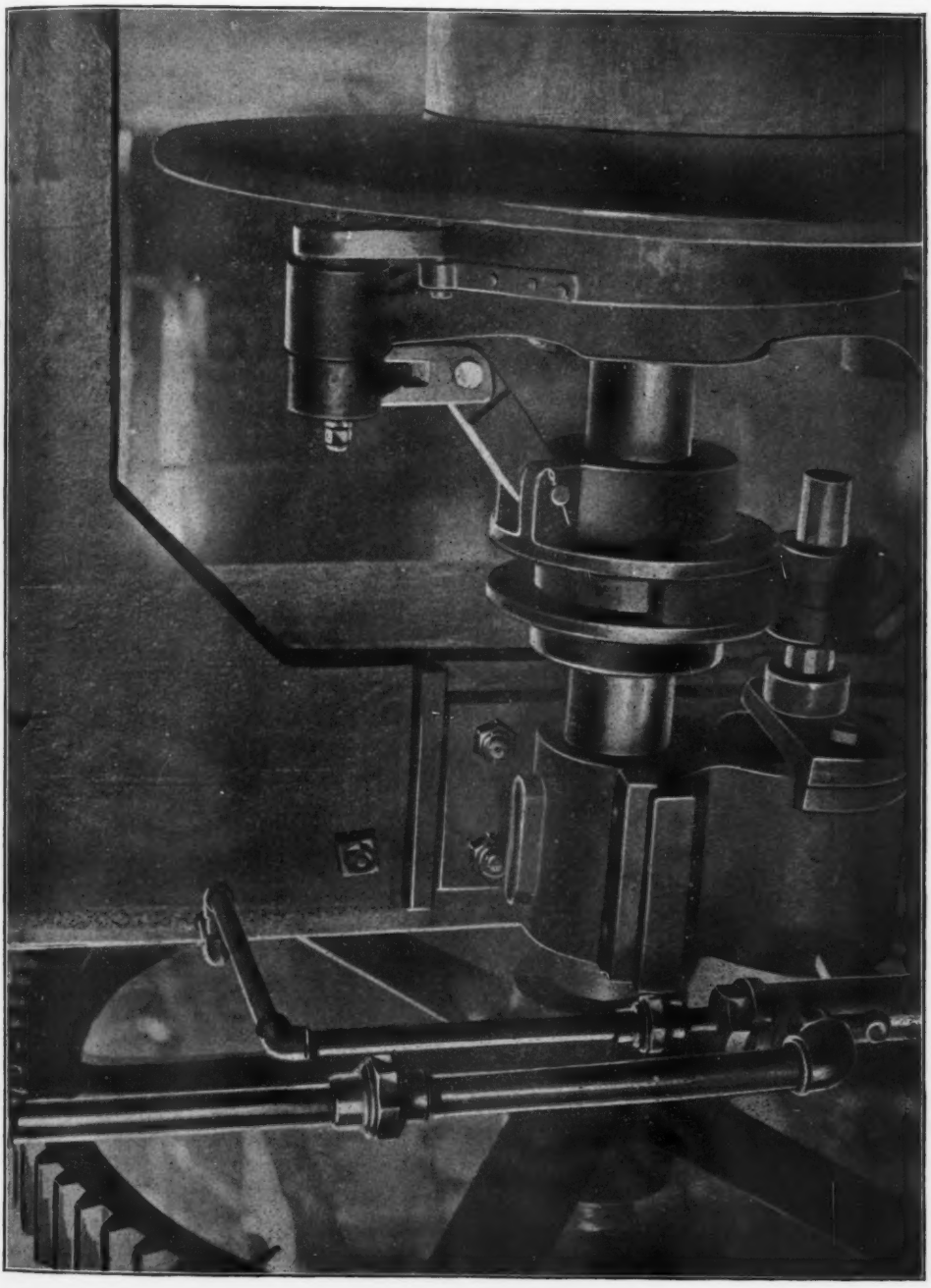
DRUM CLUSTER OPERATING FOUR SHOVELS, EACH CONTROLLED FROM HOLD OF VESSEL.



OPERATING TWO DRUM CONTROL VALVES—THESE ARE IN SHIP'S HOLD.



DIFFERENTIAL AIR VALVE ON FRICTION SETTER.



POWER FRICTION SETTER AND DIFFERENTIAL VALVE.

The ordinary equipment for a large transfer grain-house is a cluster of four drums operating four shovels. This is usually installed on the second floor of the "leg" or marine tower of the building, directly behind the large bucket belt casing or "leg," so called, which is lowered from time to time into the vessel hold that is at the building for the purpose of transferring her grain into it for storage or other purposes. Most of the grain in the vessel has to be shoveled to this leg in order to be reached by the unloading buckets.

The compressed air necessary to operate the outfit, as above described, is furnished by an ordinary 9½-inch Westinghouse pump. This compresses into a small receiver, which in turn is piped direct to the drums in the leg tower above mentioned.

Each of the drums have an ordinary strap friction released from and applied to its friction flange by an ordinary toggle connection, and this in turn is connected with the compressed air attachment, which consists simply of a small cast-iron cylinder four inches in diameter by a three-inch stroke, which is cast in and forms part of the usual bearing box, which carries the drum shaft. All that it is necessary to do is to apply and release pressure to this cylinder promptly and efficiently as before described, and in doing this apply and release the friction, which in turn revolves and stops the drum, which also in turn winds up the rope to which the shovel is attached in the hold of the grain vessel far below it.

As before stated, for sufficient reasons you must have quickness in operation, flexibility, and, above all, simple machinery.

This is arrived at as follows: piping from air receiver goes to a small differential air valve on cylinder, which is held closed by air pressure resting under its smaller area. From its larger area, or top, ¼-inch piping is led down the "leg" into the interior of the vessel or near where the shovel is being used. Also down the leg is piped a constant pressure from the air receiver.

The shovel, in order to gather the grain and drag it to the leg, has to cover the interior of a circle of fifty feet in diameter, the end of the leg being the centre of the circle to which point all the grain has to come.

The problem now is to have a valve on the shovel or in the shovel-man's hand, that will at all times open and close the differential valve on the friction cylinder far above him in the leg tower. He must also be able to do this in any part of the above-described circle as the different conditions of the work require. This is accomplished by having a small piston valve with pressure, discharge ports and an exhaust port; ¼-inch rubber tubing, of sufficient length, connects this valve with the permanent piping on leg. This tubing, taking pressure at one side of the workman's valve, is released through it, runs through opposite valve side, through other line of tubing there connected, from thence through permanent leg piping and to top of differential valve on cylinder. It reacts there and depresses valve against its lesser diameter opening it and allows main pressure piped to it to enter small friction cylinder and thus performs the desired result of applying the friction on the drum.

Travel of shovel is stopped by just reversing this described process. Workman closes his hand valve, the pressure from top of cylinder differential is thus opened to atmosphere through bottom of hand valve, pressure in friction setter is open to atmosphere through bottom of its differential valve, and thus the rotating power is stopped.

Both of these valves, for reasons mentioned, must be very simple on account of the unskilled labor employed, and must be readily, and even roughly, taken apart for oiling without any chance of being damaged.

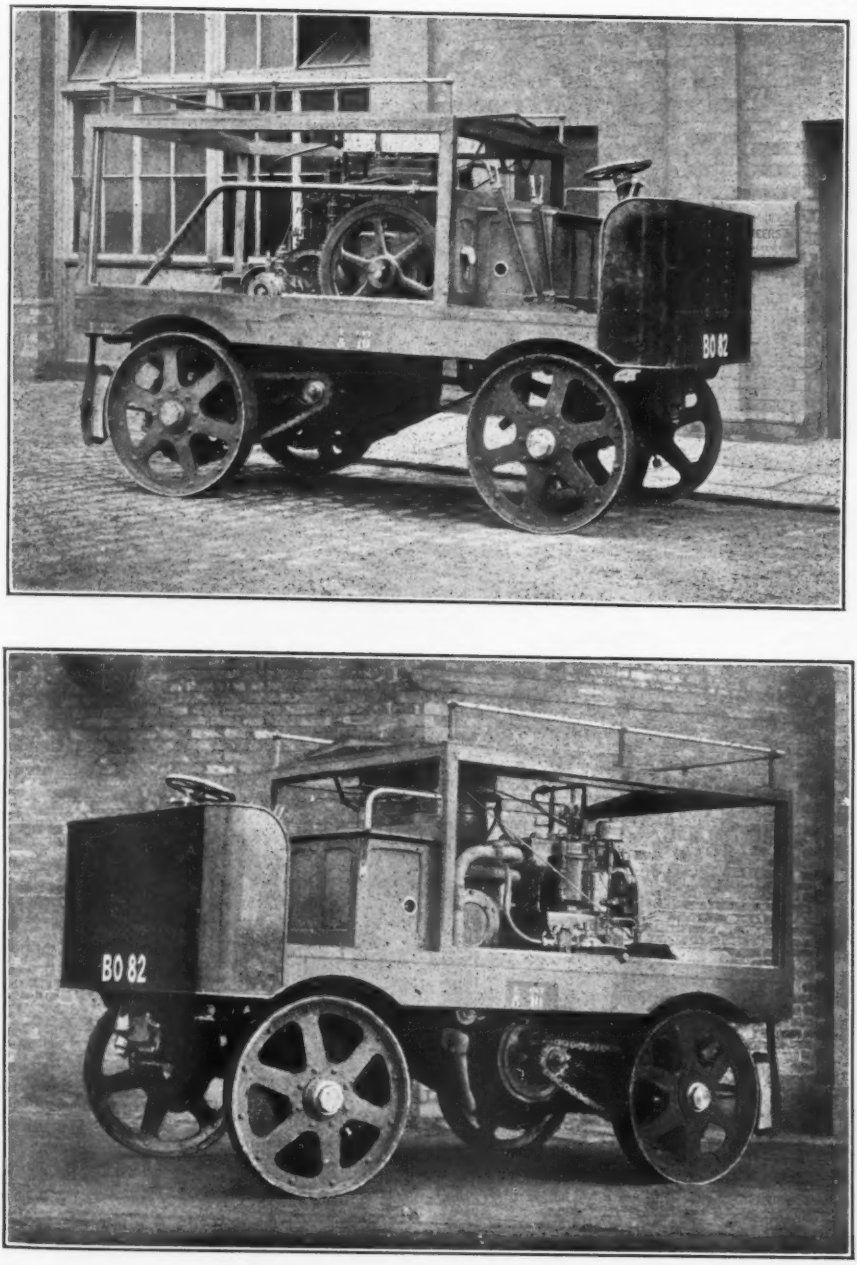
The above process is repeated throughout the vessel, and the "leg" is changed to different parts of the ship until it is entirely unloaded.

This work, before done by hand, has greatly facilitated the unloading, as each of these shovels do the work of from ten to fifteen hand scoopers.

J. G. WESTBROOK.

An Automobile Carpet Cleaning Plant.

While portable compressed air carpet cleaning plants have been in the market and in successful use for several years, it is a distinct step in advance to combine such a portable plant with an automobile truck, one engine serving to drive the truck and operate the air compressor. The idea is simple enough. When the



TWO VIEWS OF AN AUTOMOBILE CARPET CLEANING PLANT.

plant is moved about from house to house, there is no call for a supply of compressed air. When the truck reaches its destination and is ready for work, the same engine that drove it there can be connected to the compressor. Under no possible conditions will it be necessary to operate both the compressor and the truck at the same time.

Such a plant has been made by Tilghman's Patent Sand Blast Company, of Broadheath, England, for the South Wales Compressed Air Cleaning Company, Ltd., illustrations of which are shown.

This truck is equipped with a Gardiner petrol motor giving 20 brake horse power at 600 revolutions per minute. The power is transmitted for the engine to the gear box through three steel wheels. The gear box is located under the body of the wagon and contains the differential gear which drives the countershaft. Two roller chains, 2-inch pitch, connect the countershaft to the rear or driving wheels. The gear box is arranged to give forward speeds of 3 and 6 miles per hour and a backward speed of 3 miles per hour. Stearing gear and two brakes are provided.

The air compressor is of the vertical, double cylinder, single-acting type with water cooled cylinders, 9 inches in diameter by 6-inch stroke and designed to run at 300 revolutions per minute, compressing 110 cubic feet of free air per minute to a pressure of 60 pounds. It is driven from the engine crank shaft by means of a rawhide pinion and spur wheel. The crank shaft of the compressor is 2½ inches in diameter and the bearings are lubricated on the splash system.

A discharge pipe runs from the compressor to an air receiver, first passing around the frame of the truck to cool the air and thus precipitate and drain off any moisture that may have passed through the compressor. The air receiver is 4 feet long by 18 inches in diameter.

Cooling water for jackets of both engine and compressor is supplied from a tank, the connections being so arranged that the water can be used for the engine only or the engine and compressor as desired.

Two of the illustrations show the truck without the wooden panels that form the walls and roof of the box inclosing the machinery.

A Compressed Air Spray Pump and Coating Machine.

One of the latest devices utilizing compressed air is the Humphryes' compressed air spray pump and coating machine. It

A COMPRESSED AIR COATING MACHINE.

can be used for whitewash or any liquid which can be forced in a spray. It differs from many other devices of this character, in that the fluid does not pass through the pump but is forced from the large tank direct to the discharge pipe. The small tank, as seen in the illustration, is filled with air from the pump. After the large tank is filled with liquid and the valve closed between the funnel and the tank, the valve connecting the tanks is opened allowing air to pass through a pipe open in the bottom of the larger one, the air acting as an agitator and mixing the fluid. With forty pounds air pressure at the start, the tank cannot be emptied without additional pumping. It is claimed that five minutes pumping will furnish sufficient air pressure to spray continuously from 25 to 30 minutes. The machine is placed on the market by the Humphryes Mfg. Co., of Mansfield, O.

The Bryan Vacuum Molding Machine.

The name molding machine, as applied to all so-called machines, is somewhat of a misnomer, as they are generally merely used to draw the patterns. Such is the case with the machine made by the Bryan Vacuum Molding Machine Company, Lockport, N. Y. This machine is

the invention of a practical mechanic and was designed for the purpose of increasing the rapidity and certainty with which perfect molds may be set up. Most machines of this character either draw the pattern downward while the flask remains stationary or raise the flask upward while the pattern is stationary. In either of these processes there is a tendency for the mold to break, due to the weight of the sand combined with the suction occurring when the pattern is withdrawn. It was therefore deemed preferable to reverse the order in the Bryan machine, and the pattern is lifted from the sand while the flask remains stationary, practically as it would be done by hand. It is quite evident that the mold is much less likely to be broken even if the sand should be a trifle dry.

The machine, as may be seen from the illustrations, is intended to be mounted upon a post or wall, and is generally arranged so as to serve two molders, as it is required for only a part of the work, and may be used alternately by the two operators without their interfering with one another. As shown in Figure 1, the machine consists of a frame work swiveling on brackets secured to a wall or suitable upright over the molders' bench. This frame supports at its outer end a hollow rod which is movable vertically and carries at its lower end a flared cupped disk having a rubber ring on its lower face. This disk connects through a hollow rod with apparatus for exhausting air. The whole moving part is counterweighted and may be raised and lowered by means of the handle shown in the view to the right in Figure 1. The suction device is the part used to withdraw the pattern. It is usually fitted, as illustrated, with a vibrator near the sucker head,

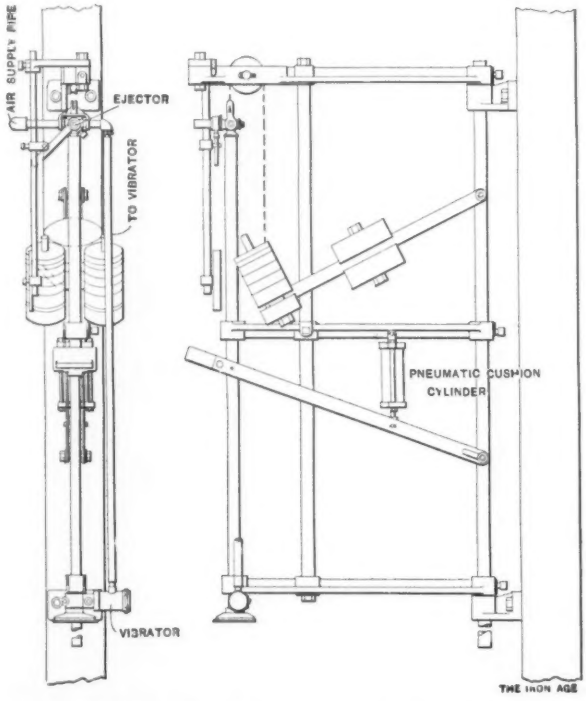


FIG. 1—TWO VIEWS OF THE BRYAN VACUUM MOLDING MACHINE.

which loosens the sand from the pattern while the latter is being lifted.

The most original feature of the machine is an air ejector, by the use of which a vacuum is created in the hollow rod through the agency of compressed air, the principle of its action being similar

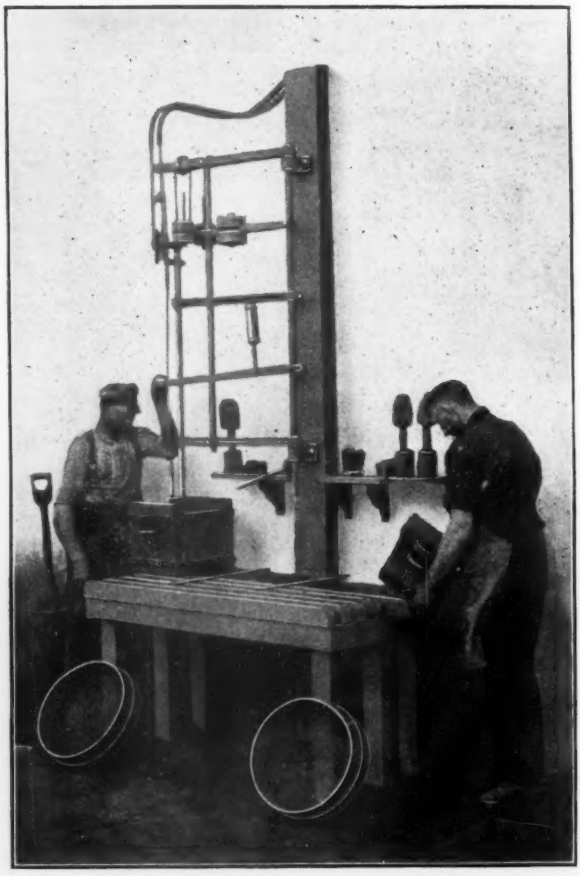


FIG. 2—THE MACHINE ABOUT TO LIFT THE PATTERN.

to that of a steam injector. It takes the place of a power driven or foot power vacuum pump, and can usually be employed, as most foundries are supplied with compressed air. This air ejector is a part of the three-way cock at the upper end of the sucker rod. The plug in the three-way cock is arranged to receive an inner pipe connecting to the passage that leads to the hollow sucker rod. Between the inner pipe and the plug cavity there is an annular space and the plug has two holes opposite each other on a line with the air supply and vibrator discharge passages. When the plug of the three-way cock is turned so that the holes in the plug are in alignment compressed air is admitted to the annular space, while a small percentage goes through the discharge passage to the vibrator. The balance of the air is discharged through the

annular space and exhaust pipe to the atmosphere, creating a vacuum in the hollow sucker rod. The ejector is operated by moving downward the lever attached to the sucker rod, causing the three-way cock lever to strike a lower tappet pin, which is secured to a rod held rigidly by the frame of the machine. This causes the plug of the three-way cock to slightly revolve, admitting compressed air, which passes rapidly over the sucker rod through the plug to the vibrator. When the sucker rod comes in contact with the pattern a vacuum is maintained until when the pattern is raised the lever of the three-way cock strikes an upper tappet pin, rotating the plug in the opposite direction to its first movement, shutting off the air and breaking the vacuum. A vacuum of 21 inches may be maintained with the air ejector when supplied with compressed air of 60 to 75 pounds pressure. This is capable of lifting a weight of about 140 pounds.

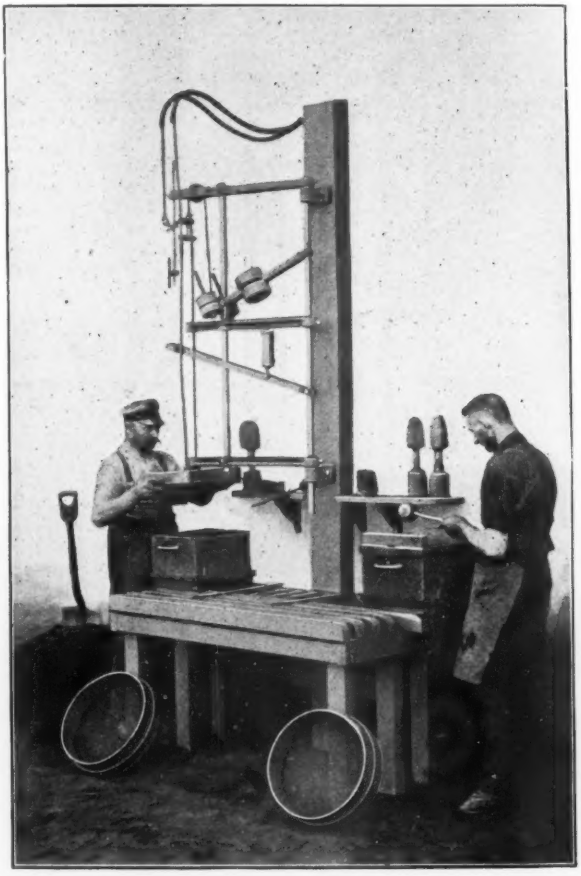


FIG. 3—THE PATTERN WITHDRAWN AND ABOUT TO BE RELEASED.

Either snap or fixed iron flasks can be used with the Bryan machine. The fixed

flasks, however, are preferable, as they retain their shape and are more durable. Patterns such as are used with this machine, it has been found, cost on an average about $8 a set, or half that amount if the pattern is symmetrical on both sides of the parting line, in which case the half pattern may be used in both the cope and the drag. A pattern of the latter sort is provided with a removable dowel pin, which is removed or replaced as required, in order to match the two parts of the flask. The patterns are mounted on boards, but it is claimed that this extra expense is soon saved in the decreased weight of the castings made with the machine, as they are more nearly the size of the pattern, there being no necessity for excessive rapping to release the pattern, as when drawn by hand. It is also

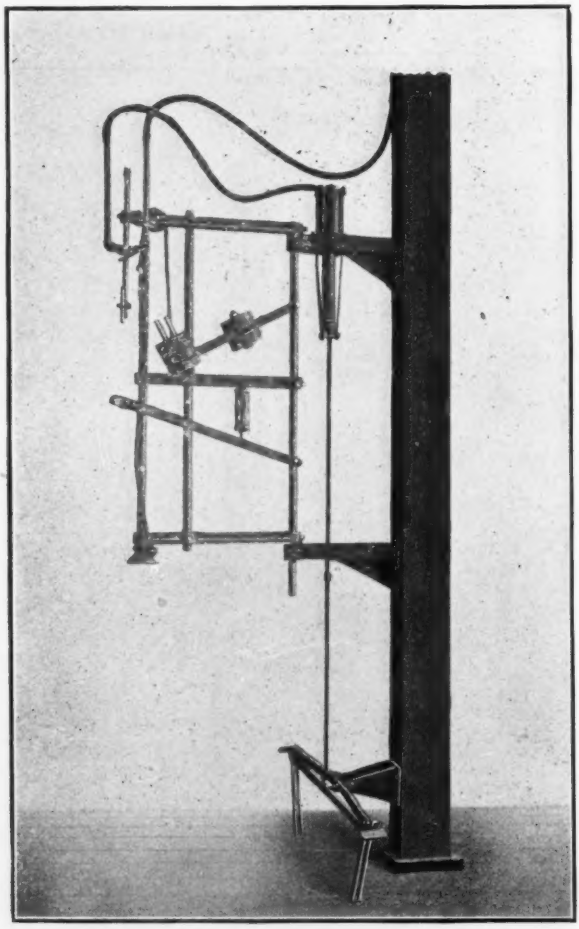


FIG. 4—A BRYAN MOLDING MACHINE WITH FOOT-POWER VACUUM PUMP INSTEAD OF AIR EJECTOR.

claimed that the machine does away with considerable patching and core making, as it is often possible to make green sand cores when making the mold, where with hand work baked cores and nails to hold them in place would be necessary.

Figures 2, 3 and 4 show the way in which the Bryan machine is used for withdrawing the pattern from the mold. The work before the machine comes into play is precisely similar to ordinary hand molding. The pattern board is placed on the mold table with the pattern up and the flask is placed over the pattern. Perfect alignment is assured by pins in the mold board and corresponding holes in the flask. Facing sand is next sifted over the pattern and the flask is then filled with regular molding sand, this being either hand rammed or pressed by a power-driven press. The sand is then leveled off to the height of the flask, a bottom board is placed upon it and the whole is turned over by hand, bringing the pattern board on top. This is the stage that has been reached by the operator at the right in Figure 2. The pattern, after being jarred, either by a mallet or the pneumatic vibrator, is then ready to be withdrawn. This operation is being performed by the left-hand operator in Figure 2. He next grasps the sucker rod lever, and, with a downward movement, brings the sucker head in contact with the pattern board at about its centre. The sucker rod is then released, as shown at the left in Figure 3, and the counterweight lifts the pattern from the mold and ascends until the point is reached where the vacuum is broken, releasing the pattern, which is then taken care of by the operator. The operator at the right in Figure 2 is about ready to use the machine, and the other is just finishing with it and will swing it within his reach.

Figure 4 shows a machine fitted with a pneumatic vibrator and a foot-power vacuum pump instead of the ejector.—*The Iron Age.*

Electric Mine Locomotives.

In connection with Mr. Clarke's paper, which appeared in COMPRESSED AIR last month, the following letters in *Mines and Minerals* will be of much interest.

Editor Mines and Minerals:

SIR—I have just seen Mr. Clarke's letter, in *Mines and Minerals* for January, in regard to a paper by Mr. W. L. Affelder, and I feel that the intent of this letter is such that I cannot let the statements made in it go unchallenged. It is not the policy of The Jeffrey Mfg. Co. to engage in a discussion of the relative merits of its apparatus with those whose evident purpose is merely to injure and annoy, but Mr. Clarke has taken occasion to create a false impression of the Jeffrey gathering locomotive under the guise of criticism of a paper written by Mr. William Affelder, and in doing so has, to my mind, wronged the author of the paper and The Jeffrey Mfg. Co. as well and has dragged in a considerable quantity of General Electric Co. bulletin advertising.

Mr. Clarke has either not read Mr. Affelder's article or is guilty of doing him a rank injustice in stating that "he has adopted an unusually partisan attitude for a paper," etc. If Mr. Affelder's article constitutes an excellent advertisement for The Jeffrey Mfg. Co. that company is to be congratulated upon having among the users of its apparatus men who speak voluntary and unsolicited praise of its machinery. I recall distinctly the Albany meeting of the American Institute of Mining Engineers in February of 1903, at which meeting Mr. Clarke read a paper describing the General Electric Co.'s gathering locomotive. I remember how a certain prominent member of the Institute, after having listened to a number of "papers" presented by employes of the General Electric Co., rose to protest against the action of the program committee in having brought the Institute together to listen to the reading of advance copies of General Electric bulletins in lieu of engineering papers. "He must have clean hands who comes into equity," and Mr. Clarke ought to consider this rule of justice before accusing Mr. Affelder of inflicting upon the Western Pennsylvania Central Mining Institute "an excellent advertisement for the Jeffrey Mfg. Co." I have read Mr. Affelder's paper and I consider it a very frank and fair treatment of his subject. He frankly states that he is "an ardent advocate of the Jeffrey locomotive," and modestly admits that he has "never used locomotives of other makes." He confines himself to that with which he is familiar. To me this seems a point of merit.

Now, if Mr. Affelder had been writing an advertisement for The Jeffrey Mfg.

Co., he would not have drawn attention to a locomotive which had met with an unfortunate accident and was out of service. Mr. Clarke shows his narrowness of vision when he draws attention to a disabled locomotive. I could, with equal propriety and equal narrowness, produce a photograph of a General Electric gathering-locomotive cable reel lying in the scrap heap beside mine tracks, having been discarded on account of troubles experienced in trying to make it a success. I might with equal narrowness and no more maliciously recite the numerous troubles which have been experienced by users of General Electric gathering locomotives, which troubles have been voluntarily disclosed to me by the "men behind the guns": motormen, mine electricians, engineers, purchasing agents, and the owners of properties. I might produce photographs showing General Electric locomotives on which the controller and resistance had been replaced by those manufactured by The Jeffrey Mfg. Co., but I do not want to stoop to small things. My only object in writing this letter is to keep from having, if possible, a false impression of the Jeffrey gathering locomotive gain credence.

Mr. Affelder described broadly the Jeffrey gathering locomotive and presented to the members of the Institute an illustration of the locomotive. It was a comparatively new machine, the application of a locomotive to new duties, and it was undoubtedly of great interest to the Institute. Mr. Affelder gave, in his paper to the Institute, a great deal of other data of value to engineering, and we wonder whether Mr. Clarke can lay claim to as much in his paper describing the General Electric gathering locomotive under the pretentious title of "Electrical Apparatus for Coal Mining." Mr. Clarke makes the statement that "the cable reel shown in the illustration is located in such a manner that it is certain to be wrecked by the first car that climbs on to the locomotive." Our letter is not intended as an explanation of why we design and build our locomotive as we do. Sufficient to state that the design we have followed has in actual practice been found the best design from the standpoint of the purchaser, and within the week has been commended by one of the largest users of electric mine locomotives in the world. In referring to our gathering locomotive, which he had in use in his mine as well as one of the locomotives built by Mr. Clarke's company, he stated: "It is a great satisfaction to have a locomotive where it is unnecessary to employ from four to six men and to provide a special crane to lift off the reel in order to lubricate not only its mechanism but to fill the grease boxes of the motor bearings."

We would take issue with Mr. Clarke's statement that the General Electric Co. was the first to place a practicable locomotive of this type on the market. I cannot but feel that Mr. Clarke's complaint that Mr. Affelder places the General Electric Co.'s locomotive in the "also ran" class comes from an inborn sense of the justice of such a classification. In the light of experience I am inclined to think that Mr. Affelder gave quite sufficient prominence to the gathering locomotive of the General Electric Co. This conclusion seems to be amply justified by the remarkable number of inquiries for gathering locomotives received by The Jeffrey Mfg. Co., many such inquiries coming from those who have tried other makes, also by the duplicate orders received from parties who have been using Jeffrey gathering locomotives.

After reading over what I have written I feel perhaps that I have given too much importance to the letter of Mr. Clarke and it might have been much more dignified on my part had I ignored the letter, but I feel that in view of the ridicule which Mr. Clarke has brought upon Mr. Affelder some notice should be taken of same.

Yours very truly,
S. B. BELDEN.
Pittsburg Office, The Jeffrey Mfg. Co.

P. S.—Since writing the above letter The Jeffrey Mfg. Co. has been awarded a contract for coal cutters and locomotives by the Vesta Coal Co. of California, Pa., which, I should think, would go a long way toward convincing such persons as may have read Mr. Clarke's letter, that Mr. Clarke's opinion of Jeffrey apparatus is not shared by the Vesta Company, and that Mr. Affelder is not alone in his esteem of Jeffrey locomotives.

S. B. BELDEN.

In the January issue, page 296, a communication appeared from Mr. W. B. Clarke, of the General Electric Co., under the above title criticising an article, by

Mr. W. L. Affelder, read before the Western Pennsylvania Central Mining Institute, December, 1903, and printed in *Mines and Minerals*, March, 1904. The following is Mr. Affelder's reply, addressed personally to Mr. Clarke, but published here by permission of Mr. Affelder:

MOSGROVE, ARMSTRONG COUNTY, PA., January 12, 1905.

W. B. Clarke, Esq., General Electric Co., Schenectady, N. Y.:

DEAR SIR—I have read with considerable interest your article in this month's *Mines and Minerals*, and it seems to me that an answer would not be out of place. I prefer, however, to answer you privately, as I do not care to become a party to a public discussion between two rival manufacturing concerns. I agree with you entirely that I have taken somewhat of a partisan stand regarding the Jeffrey locomotives, and I made no attempt in my paper to conceal that fact. This is due to several conditions which I will mention.

Please note my statement on page 381, of the March, 1904, *Mines and Minerals*, which reads in part: "Unless locomotives made by the several prominent manufacturers were operated under exactly similar conditions and the results noted, it would be practically impossible to make direct comparisons between them. One operator swears by the General Electric locomotive, and another would not have one as a gift and would have none but the Morgan-Gardner, etc. The writer is personally an ardent advocate of the Jeffrey locomotive, but this may be due to the fact that he has used no other."

You doubtless recognize the fact that a mine superintendent is not necessarily an authority on theoretical electricity, but bases his deductions in this line almost exclusively upon practice. I have had something over 5 years' experience with Jeffrey locomotives, and was entirely frank in admitting that I had had no experience with any other make. Inasmuch as our 10-ton Jeffrey, in 1904, hauled 80,000 cars of coal (97,000 tons) and 8,000 cars of rock and fireclay, covering a total distance of 4,950 miles, the loads being hauled up several hundred feet of 3-per-cent. grade and the empties up 300 feet of 4-per-cent. grade, and accomplished this with absolutely no burn-outs, without a single break down, and without a single repair excepting legitimate wear on bearings and wheels, my confidence in the Jeffrey is in no degree impaired. However, quoting my paper, "Yet each operator using one make might get just as good results from any of the others." Your quotation from Fra Elburtus is apropos from your standpoint, but you are criticising me for assuming that the Jeffrey is the best, and in the next breath saying that the General Electric is the best.

There is another reason why I dwelt so extensively on the Jeffrey locomotives: they were the only manufacturers who thought it sufficiently worth their while to favor me with any quantity of data and photographs. Several other companies, yours included, sent me a few photographs, but the Jeffrey Company was the only one that inconvenienced itself to the extent of really affording me any active cooperation. In a way, my paper as published is a little misleading, on account of many of the photographs not having been reproduced. I presented illustrations of your locomotives and of those of several other manufacturers when I read my paper at the Mining Institute meeting.

If you will note the introduction to my paper, you will note that the paper was intended more as a discussion of third-rail systems, not because I am especially friendly to this style of haulage, but because I believe in taking comparatively new subjects for my papers instead of rehashing an old subject. It was, therefore, necessary to pass over all traction locomotives in a general sort of a way and to describe one make of traction locomotive as a representative of that particular type. I therefore took the Mosgrove "Jeffrey," which I installed and was most familiar with, not because I was trying to sell Jeffrey locomotives or any other kind, but because I did not want to make definite statements about a make of locomotives with which I was not familiar.

The same applies to gathering locomotives. I could give them but brief mention, and therefore merely described the Jeffrey and Baldwin-Westinghouse, which I had actually seen in operation at Vesta. Unfortunately the Baldwin-Westinghouse Co. could not provide me with a photograph at that time.

In your communication, you have placed me in a very unfair light in your statement: "Mr. Affelder's paper is accompanied by an illustration of a Jeffrey gathering locomotive with an automatic cable reel, which would naturally imply

that this machine is in successful service." It "did imply" but that is no reason why it still "implies." Why should I be held responsible for the fact that this device has proven unsatisfactory, when it was in comparatively successful operation when I visited the mine 6 months before the article appeared in print? I agree with you entirely that this locomotive was not a success, but at the time when I visited the mine and secured the data regarding it, it was comparatively new and was considered pretty good.

Did I not entirely protect myself on page 382 when I wrote: "Even though gathering locomotives have not passed far beyond the experimental stage and some improvements must be made, especially in securing a satisfactory method of taking care of the cable, it can readily be seen that this style of locomotive will rapidly meet with favor, etc."

I am aware that the Jeffrey gatherer has been practically rebuilt so far as electrical equipment is concerned, but again I see no reason why I should be held responsible for a change that has been necessitated since I originally inspected the locomotive. The Vesta Co.'s electrician is a former Jeffrey man, and he frankly admits that while their locomotives are excellent for 250 volts, they are not very successful on 550 volts, as the insulation breaks down. I agree with you that I dismissed the General Electric gatherer with a few words. Why should I have done otherwise, when I have never seen one and my paper was not intended as a paper on gathering locomotives?

Mines and Minerals for February will contain a very complete description of the Vesta No. 4 Mine from data which I secured when I spent several days at the mine last October. I am sorry that I was unable to see your locomotive in operation at that time, as it was then being rebuilt in the Vesta shop. I say of it in part: "With the exception of the General Electric and one of the Baldwin-Westinghouse locomotives, the gathering locomotives are equipped with simple hand reels, etc. The General Electric locomotive is equipped with a flat reel which is operated by being connected to one of the axles by means of sprocket and a chain.

"A hand lever operated by the motorman regulates the winding or unwinding of the cable. Both cable devices are working satisfactorily, and a number of the locomotives will soon be equipped with automatic reels to replace the hand reels now in use." Space prohibited detailed descriptions of the locomotives, as you well know that the Vesta Mine is hard to describe in a brief magazine article.

With the best of feelings toward all electric locomotive manufacturers, and "with malice towards none," I am,

Very truly yours,

WILLIAM L. AFFELDER, *Superintendent.*

McGrath Pneumatic Turntable Motor.

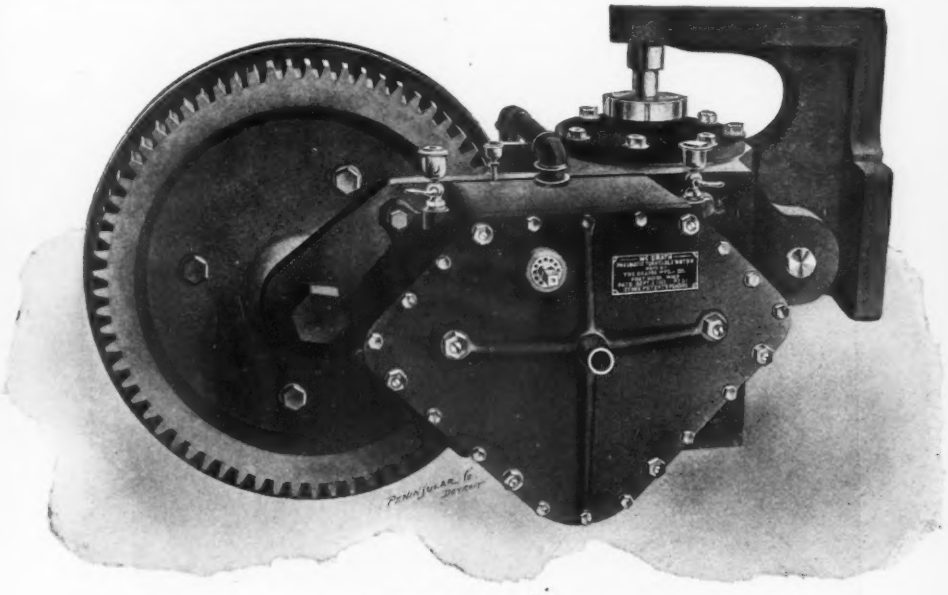
The engravings show the McGrath pneumatic turntable motor. Its component parts comprise a motor box, frame, gear and friction wheels, and hinge bracket. The motor box is bolted to the side of the frame (Figure 1), and between the shears of the frame are the machine-cut gear wheel and flanged frictional wheel, 25 inches in diameter. These are bolted together, bushed with a bronze bushing, and revolve on a 2-inch steel axle. Directly behind these wheels is a cylinder of 10-inch bore. The hinge bracket is bolted to the side of the turntable, and the frame is attached to this by a 2-inch steel pin, which allows the motor frame, etc., to rise and fall with the unevenness of the circle rail in the pit, and also allows for the tilting of the table. Inside of the motor box are the oscillating brass cylinders, 4 inches by 4½ inches. On their crank shaft, outside of the motor box, is a steel pinion which engages the 25-inch gear wheel.

When the air is admitted to the motor box it also enters the lower part of the 10-inch cylinder in the frame. This forces its piston rod up against the arm of the hinge bracket, and so forces the friction wheel down in contact with the circle rail in the pit. Both ends of this frame cylinder are fitted with stuffing boxes. The piston rod extends through the lower end of the cylinder, and to it a brake shoe is attached, which slides up and down in ways in the frame. When air is admitted to the upper end of the frame cylinder it forces this brake shoe against the rail, lifting the friction wheel from contact with the rail and bringing the back of the motor frame against the bracket, which effectually stops the table at any point.

Figure 2 shows the motor attached to a table, also the position of the platform and of the operating handle. The motor

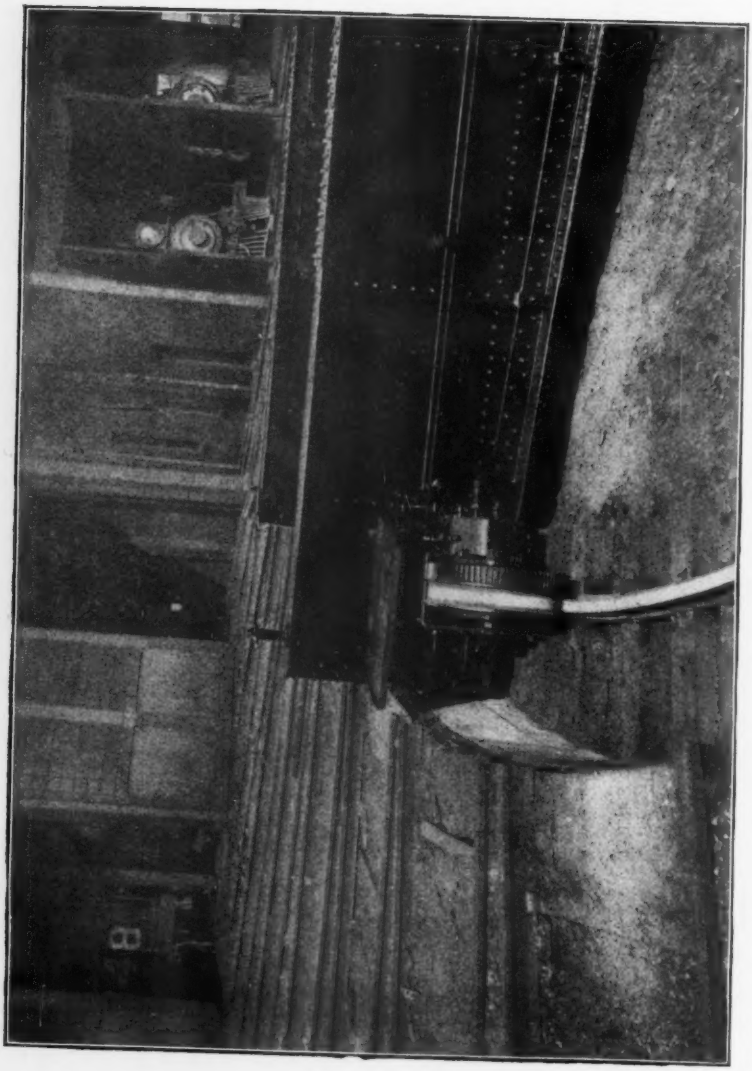
is reversible and under complete control from the operating lever. The lower part of the operating lever rod is connected to a rotary valve which admits air to the motor box and to the lower part of the 10-inch cylinder. The reversing valve in the motor box is connected with the operating lever and is so arranged that when the latter is on the centre the former is also, and all the ports are closed. This also closes the rotary valve and opens the relief port underneath it, which allows the air to escape from the motor box and from below the piston in the 10-inch frame cylinder. When on the centre the operating handle is directly over the rod operating the brake valve. By lifting the handle of the operating lever, which is pivoted in the centre, the opposite end presses down the brake-valve rod and opens the valve, admitting air to the top of the 10-inch cylinder and forcing the brake shoe against the rail. When the handle is lowered the brake valve closes, and the pressure above the piston in the frame cylinder is relieved by the air escaping through a relief port in the brake valve. This arrangement makes it impossible to operate the brake and the motor at the same time.

There may be three independent sources of air supply to the motor: (1) Connected to a shop plant and conveyed through a revolving connection in the centre of the table; (2) from the air pump on the engine being operated and coupled either to the hose on the tender or pilot; (3) from an engine standing on the track near the table, and connected through the revolving connection, the same as from the shop plant. The last is convenient in many cases to turn cars or a dead engine when the shop plant is not available. When this plan is used, a circular pipe can be placed around the top of the pit, with hose attachments at convenient intervals around the table.



THE McGRATH PNEUMATIC TURNTABLE MOTOR.

These motors are made by The Draper Manufacturing Co., Port Huron, Mich. Installations have been made for a number of roads, including the Grand Trunk, Baltimore & Ohio, Pere Marquette, Lehigh Valley, Philadelphia & Reading, Long Island, Santa Fe and Canadian Pacific.—*The Railroad Gazette.*



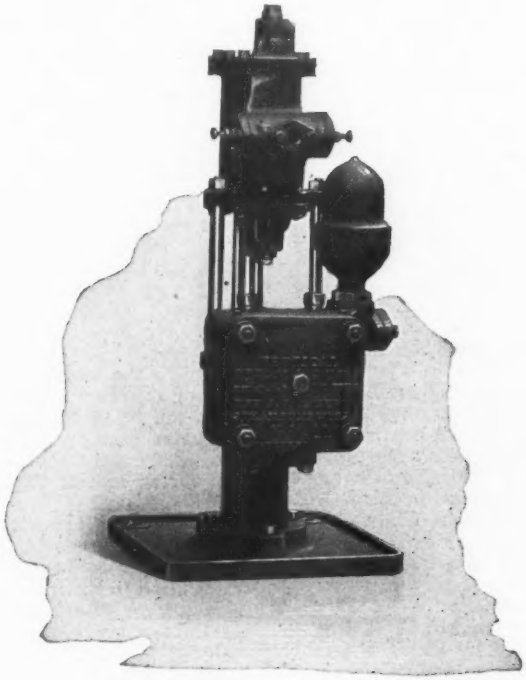
SHOWING THE McGRATH MOTOR IN POSITION ON TURNTABLE.

Cameron Vertical Boiler Feed Pump.

When men, who manage manufacturing or other industrial enterprises, find it necessary to purchase a modern pump, they naturally investigate to determine which make of pump will afford the best satisfaction for the duty to which it is to be adopted. In general, as with most other mechanical equipments, the pump which combines the features of security, durability, and efficiency with economy in the cost of maintenance, is the one which the buyer seeks.

There are many types of pumps and there are many combinations and adaptations of types of pumps, and combinations and adaptations of steam or air and water cylinders, that are possible for various uses. But it is the intention here to refer to that commonly used machine, the boiler feed pump, the design and construction of which do so much, when the pump is a successful one, to add to the efficiency and satisfactory results obtained from its use.

Men who have technical and engineering knowledge of modern pumps are well aware that the product of the A. S. Cameron Steam Pump Works is renowned for meeting all the conditions for which they are designed and proportioned, and there is scarcely any part of the world that could be mentioned, where Cameron pumps are not in satisfactory use. They are sent to districts so remote from the ordinary transportation facilities, in the farthermost corners of the world, that the most primitive means of mule-back carriage are resorted to in conveying the various parts of their sectionalized pumps to their destination.



CAMERON VERTICAL BOILER FEED PUMP.

For boiler feeding the company lists, among other types, the Cameron vertical boiler feed pump—an illustration of which is presented herewith. The photographic

reproduction shows a vertical piston pump on a base. It possesses every necessary attribute of a perfect direct-acting pump, occupying but little space and giving the maximum capacity. Although shown on a base plate, it is sometimes preferred for marine use to bolt the pump, by means of lugs cast on the back, to the bulkhead. This has been done in the case of pumps of this type furnished to the smaller gunboats and which have seen quite active service in the U. S. Navy. In common with all Cameron pumps, no working part is exposed except a small part of the rod, which may also be covered, if necessary. The steam end may be adapted to work under any steam or air pressure, no matter how high, and the water end is fitted with Cameron patent priming valves, and a removable bushing or lining which may be taken out and replaced with a new one in a few minutes.

Pump users and buyers are invited to address the main offices and plant at the foot of East 23d street, New York City, and ask for a pamphlet.

Electricity vs. Compressed Air for Mines.

A meeting of the Birmingham Local Section was held on February 15, 1905, Dr. Sumpner presiding, when a paper was read by Mr. A. C. Anderson on "The Application of Electricity to Mines," an abstract of which has already appeared in this journal. In the discussion which followed, and which was very interesting, Mr. Jackson referred to a paper which had recently been read before the Rugby Engineering Society on "The Application of Electric Power in Collieries," by Mr. G. M. Brown. This paper embodied his views to a large extent. Where slip-ring motors were used he recommended the use of more than one brush per ring, as this reduced liability of sparking. A frequency of 50 cycles per second was usually found most convenient.

Professor Redmayne (Birmingham University) said that he favored electricity as a motive power in mines. Steam and compressed air were, however, still largely used. Compressed air would continue to be a formidable competitor to electricity so long as there was any liability to sparking troubles with electric systems. Too much stress could not be laid on this question. In many cases its occurrence might result in an explosion. The author has quoted 30 per cent. as an efficiency figure in connection with compressed air systems. Very old plants might show this figure, but modern systems, employing isothermal compression combined with reheating, had frequently an overall efficiency as high as 70 per cent. But thermal efficiency was not such an important consideration as simplicity of apparatus. This was an absolute necessity in mining work, owing to the conditions of space and lighting. It was a moot point whether electricity or compressed air was the better system of power to use. In the majority of instances that had come under his notice, the quality of material and workmanship put into electric installations in mines and collieries was extremely good. With respect to drilling, it was a fact that electricity had absolutely failed to compete with compressed air as a motive power. There were several electric drills, more especially of the rotary type, that would do good work, but they were not suitable for mines. They were much more complicated than pneumatic drills, and more costly in upkeep. He hoped that a suitable electric drill would be designed. The figures quoted by the author to show the relative cost of different systems of coal cutting could not be taken as reliable. To be of any value each system would have to be tried at the same spot, as the hardness of coal varied considerably even in the same pit.

Mr. Reavell (Ipswich) advocated air compressors used in conjunction with electric generators at pit head, and electric distribution to different parts of the mine. This system would reduce first cost and result in a greater economy of working than any other. The electric power might be used for all suitable work, such as pumping, etc. But pneumatic machinery was most suitable for coal-cutting, drilling, etc., and the compressed air for these could be supplied by an electrically-driven air compressor through short lengths of pipe. Coal-cutters frequently jambed. With a pneumatic tool it was a simple matter to cut off the air supply, withdraw cutter and make a fresh start. But in the case of an electrically-driven machine it meant the replacing of a fuse and a consequent delay. He then showed a lantern slide illustrating a portable electrically-driven air compressor suitable for the work he had indicated. Another advantage result-

ing from the use of compressed air was its storage capacity. With a system entirely depending upon electricity, the generating plant had to have a capacity capable of dealing with the whole of the equipment. He condemned compression at the pithead as it frequently resulted in a loss of 50 per cent. of the power generated.

Mr. M. B. Wild regarded the choice of system as not settled by the question as to which was the cheapest to instal in the first instance, but by what system one could pull out the greatest amount of coal with ease and safety. He found that with D.C. plants considerably more power in motors could be put below ground than with A.C. plants for a given power of generator on surface. Again, with D.C. there was no trouble due to motors falling out of step and causing stoppages, when the generator was momentarily overloaded. D.C. motors properly designed for secondary haulage, and a suitable reversing controller with sufficient resistance, constituted an electric haulage gear as flexible as a steam or compressed-air hauling engine; there should be no necessity to use a friction clutch, which many electric engineers had to do to get over defective starting gear, such as liquid switches and badly designed controllers. For pumping and very large haulage, such as endless-rope, main and tail with long runs, no doubt A.C. would be the better system. From personal experience he had every confidence in saying that in most collieries the haulage could be done by electricity, or in very fiery mines with compressed air generated by an electrically-driven compressor placed as near as possible to the gears consistent with safety.

Mr. H. M. Hobart (written communication): Continuous-current and polyphase systems have both been successfully employed in the application of electricity to mines, and the relative merits of each system for any particular case should always be weighed before arriving at a decision. As the writer is satisfied that both systems will find wide fields of usefulness in such work, he does not propose to discuss their relative merits on this occasion, having recently done so in the discussion of Mr. Holiday's Paper, entitled "A Comparison of Three-Phase and Continuous Currents for Mining Purposes," read before the Institution of Mining Engineers, June 2, 1904. In those cases where the use of polyphase currents is most suitable, it is of paramount importance to employ a low periodicity, for it is the power applications which are of chief importance in mining, and any questions relating to the quality of the lighting, are of secondary importance. Moreover, it is a fallacy to regard the question of lighting at low periodicities as offering grave difficulties. The lower the periodicity the lower should be the voltage chosen for the incandescent lighting circuits, and the higher should be the candle-power per single lamp; for by these means the carbon filament employed will be of sufficiently large section to be able to store the heat and obviate material reduction of temperature between the peaks of current of successive cycles. It will necessarily follow that the luminosity will then be more constant. But the chief desideratum, that of excellence in the design and performance of the motors, is enormously promoted by the use of low-frequency. This will lead to higher-power factors, lower magnetizing current even with larger air gap, greater overload capacity, and also cheaper motors, since for a given output the diameters will be smaller and the lengths greater. Capacity effects in the cables will also be decreased. The squirrel-cage type should be freely used, even in motors of large capacity.

Mr. Anderson in his reply admitted that steam was still largely used, but there was no doubt that the losses in the distribution system were of a most serious character. "Economy of coal cutting" was impossible with a "wholesale waste in pipes." Undoubtedly, mining engineers, as a body, regarded fuel economy as of considerable importance. The modern electrical equipment of collieries was very good in most cases; but bad early work had been prejudicial to progress of electricity in mines. The electrical equivalent of the compressed-air storage system was the battery, a most convenient factor. It was a very difficult matter to obtain reliable comparative figures of coal-cutting performances, as the conditions of working were so various. The replacement of fuses in connection with coal cutters driven by polyphase motors was of rare occurrence. Liquid rheostats were very good as starters; for variable speed work the ordinary type of regulator would be used. The advocacy (Mr. Hobart's) of a low frequency was very interesting, but the low voltage necessary for successful lighting would hardly conduce to the best

economy. The system of starting motors by running up with the generator added considerably to the capital outlay, as separate circuits were necessary. He agreed with the remarks that had been made about the necessity of employing machinery of as simple a nature as possible.

The meeting concluded with a vote of thanks to the author.—The Eng. *Times* (Eng.).

The River Dee Tunnel.

Subaqueous tunneling methods in Great Britain are interestingly described in the accompanying article which appeared in an Aberdeen daily paper.

The operations in connection with the construction of the Girdleness outfall sewer scheme have now reached a most interesting stage, a satisfactory start having been made with the tunneling of the river Dee from the Torry side of the river to Point Law. The tunnel, which will be 114 yards in length, is being constructed for the purpose of connecting the sewerage of the city on the north bank of the river with the main outfall sewer which has been completed on the south side. When finished it will form an inverted siphon through which the sewage will be conducted from the level of the sewer on the north bank of the river, under the bed of the stream, and up to the level of the sewer on the Torry side. As a necessary preliminary to the making of the tunnel, a cast-iron shaft 13 feet external diameter has been sunk on each side of the river. The shaft on the Torry side has been sunk to a depth of 72 feet below the surface of the ground, or, in other words, about 66 feet below high water mark, while at Point Law the shaft has been sunk to a depth of 58 feet below high water mark. By a joint arrangement between the Town Council and the Harbor Commissioners, permanent quay walls have been built on both sides of the river, and special openings have been left in these to receive the tunnel. The work of mining is being carried out from the Torry side of the river, where all the necessary plant has been erected. The tunnel is being driven 20 feet below the bed of the river, and owing to the inrush of water which took place when the operations were commenced, it has been found necessary that the work should be done with the assistance of compressed air. A complete plant for the supplying of compressed air to the tunnel is now at work, and has proved eminently satisfactory. The construction of the tunnel is a most interesting piece of engineering work, and through the courtesy of the Resident Engineer (writes a representative of the *Free Press*), I was enabled to view the operations the other day. Owing to the special difficulties that have been met with and have had to be overcome, the construction of the Dee tunnel has necessitated the employment of great engineering skill, and it is quite a unique undertaking, so far as this country is concerned, at present.

In order to obtain an intelligent idea of what has been undertaken, I was conducted over the entire works by the Resident Engineer. Our first visit was to what is now known as the Compressor House—formerly, in a different guise, known to Aberdonians as the engine-house of the old Torry brickworks—situated about 200 yards to the west of the shaft leading to the tunnel. In the Compressor House has been fitted up a complete plant consisting of two Ingersoll-Sergeant air compressors. These are arranged in duplicate, either engine being capable of supplying the amount of air necessary in the tunnel. The reason for duplicating these machines is obvious; any failure to supply the requisite amount of compressed air would result in an inrush of water to the tunnel, which would be fatal to the workmen, and it has therefore been deemed advisable to have two engines at work in case of any breakdown. The engines are of beautiful build, and are worked at a very easy speed. By means of them air is drawn in from the outside atmosphere, and is driven into the tunnel, the supply being equal to about 4,000 or 5,000 cubic feet of free air per hour for every man engaged in the mining and construction. At the time of my visit the air was being supplied to the tunnel at a pressure of 13 pounds to the square inch above ordinary atmospheric pressure. After inspecting the boiler house adjoining, we proceeded to the Torry shaft for the purpose of descending to the tunnel. Here we descended a short distance by means of ladders, and entered what is known as an "air lock." This is formed of two steel floors placed across the shaft, six feet apart, which form an air-tight compartment. Entrance is obtained by an opening in the upper floor, which can be closed by

a cast-iron door. Once inside this airtight compartment, the opening was closed, and compressed air was admitted gradually until the pressure within was equal to that of the air in the tunnel. The sensation of breathing compressed air for the first time is curious, but not at all disagreeable. The air lock is filled by the sound of the air rushing in, and the novice experiences a slight deafening sensation arising from the unwonted pressure from without on the drums of the ears. This feeling is quite easily got rid of by the simple expedient of gripping the nose tightly and "blowing," or by simply swallowing the saliva in the mouth. Persons with weak hearts are liable to be distressed by the action of the air, but all the men employed on the works have been medically examined and found to be thoroughly sound and fit.

When the air pressure in the lock had reached that in the tunnel, a cast-iron door in the lower floor, similar to that in the upper floor, was opened, and we descended to the tunnel proper. It may here be mentioned that the most elaborate precautions are taken to insure a steady supply of air at the necessary pressure. On the upper floor already mentioned are placed gauges showing the amount of pressure in the tunnel and in the air lock; here are also fitted up telephones by which the man in charge of the lock can communicate with the compressor house and with the tunnel. By means of these the man in charge can ascertain exactly how the workers in the tunnel are faring and can also regulate the supply of air from the compressor house, lessening or increasing it as may be found necessary. Air pipes are also seen here, the purpose of these being to pump out any water that may percolate through to the tunnel. In order that long materials may be passed down to the tunnel, a steel tube has been built up above the level of the upper floor of the lock, and this is sufficient to admit of the lowering of rails sixteen or seventeen feet long, which could not pass through the ordinary lock.

On my arrival in the tunnel proper, which is 20 feet below the bed of the river, I found that considerable progress has already been made. A length has already been constructed of blue brick work. The brick work is 25 feet long, and forms what is called a shield chamber. The construction of this chamber has been rendered necessary because of special difficulties which the engineers have had to contend with as a result of the water bursting in during the early stages of the work. All risk of this happening in future has been obviated by the employment of the compressed air, and the safety of the workmen, in case of any inrush of water from above, will be further insured by the employment in the subsequent operations of a hydraulic tunneling shield. At the time of my visit the shield was lying at the bottom of the shaft, and below the level of the tunnel. It had been placed there at the commencement of the tunneling operations, as it would have been impossible to lower it into the tunnel after the air-lock had been constructed. The shield was to be raised into position in the brick work on the day following my visit. The shield appears to be simply a huge cylinder of steel, 6 feet 6 inches long and 8 feet 8½ inches in diameter, and weighing about 12 tons. In front of the shield is a sharp cutting edge, and, as the work of excavation proceeds, the whole mass of steel work will be driven forward by means of powerful hydraulic rams with which it is fitted, the necessary resistance for the proper working of the rams being supplied, in the first instance, by the brick work already constructed. The shield will move forward 22 inches at a time, and as it progresses, a space is left behind it, which is filled with cement grout by means of a grouting machine supplied with compressed air by means of a separate compressor independent of those already described. The tunnel proper will be built by the placing in position, in the space already prepared, of shield of cast-iron segments. The construction of the shield is such that whether employed in the work of excavation or in the placing of the segments, the miners are completely under its protection. The hydraulic rams driving the shield will work at a pressure of one ton to the square inch, and as the tunnel progresses through the bed of the river, the resistance required will be provided by each successive ring of the tunnel. By the employment of the shield, which is in no way a tunneling machine, but simply what its name implies, a great deal of labor hitherto necessary will be obviated. The protection of the men and the prevention of the subsidence of the bed of the river has up to now been secured by the rather laborious process of "timbering," but now that the brick work has been com-

pleted and the shield brought into use, "timbering" will be dispensed with. After the tunnel has been driven, an upright steel diaphragm will be bolted to special flanges in the segments, and the whole will be lined with concrete, thus dividing the tunnel into two divisions and forming duplicate siphons. These two divisions will be connected to 4½ feet internal diameter cylinders within the shafts. By this construction it will be possible to clear either division of the tunnel when necessary, without deranging the sewage system. At Torry arrangements will be made for dealing with the "sludge," and an electric pumping plant will be fixed in the shaft for emptying either siphon during cleaning operations.

In the tunnel it was difficult to realize that one was underneath the Dee, and that one had to draw breath under abnormal conditions. The place was perfectly dry at the time of my visit, and I was informed that although a little water does find its way through in places, it can quite easily be drawn out by the pipe already referred to, and the engineers prefer to do this rather than to increase the pressure of the air in the tunnel. The amount of water which percolates through is comparatively small, and does not at all interfere with the comfort of the miners or the progress of their work. So far as breathing was concerned, even one unaccustomed to such an atmosphere experienced no discomfort, and the miners worked without the least apparent inconvenience. The pipe conveying the air into the tunnel is placed near the spot where the men are engaged, and it will be shifted forward as the operations progress. The air is exceedingly pure; indeed, the result of analysis proves that it is of a greater degree of purity than that of an ordinary dwelling house. The 4,000 or 5,000 cubic feet supplied per hour for each man is necessary to prevent the accumulation of too much carbonic gas, and every precaution has been taken to keep up the requisite amount of pure air. The whole of the works are lit by electricity, so that the air can be kept as pure as possible.

As has already been explained, the pressure of air has to be kept up constantly, and as this requires the continual working of the compressors, and consequently a steady expenditure of money and labor, it is expedient that the work of construction should not be interrupted. With this in view, the work has been arranged in three daily shifts of eight hours each. The week's work commences at 10 o'clock on Sunday evening, and ends at the same hour on the following Saturday. Night and day, therefore, the work of construction goes steadily on with the exception of the period between 10 o'clock on Saturday evenings and 10 o'clock on Sunday evenings. Cases of compressed air illness have been experienced in similar undertakings, but in the case of the Aberdeen works, the men engaged have, as stated, been certified as thoroughly sound, and, as the air pressure, though it may at some future time have to be increased, will never exceed 20 pounds above atmospheric pressure, there is little reason to fear that any of the men will suffer. The contractor and engineers have, however, left nothing to chance, and on leaving the tunnel and regaining the outer air, I was shown an interesting apparatus for the treatment of any who may be affected by prolonged working in the tunnel. It has been found that a common cause of illness is impure air and the too rapid transit of workmen from the tunnel to the open air, and the result of this is that, whereas in descending, one has to spend some four minutes in the air-lock in order to be gradually "acclimatized" for the subsequent descent to the tunnel, the time occupied in the lock on the way up is about seven minutes. In case of anyone being attacked by compressed air illness, therefore, a medical air-lock has been provided close to the entrance to the shaft. In appearance, the medical air-lock strongly resembles a horizontal boiler, the interior of which is fitted up somewhat after the fashion of a stateroom on board ship. The furnishings of the lock are, indeed, not on a scale of such luxury as are to be found on an ocean-going steamer, but they are quite adequate for the purpose. The lock is divided into an outer and an inner compartment. Should a man be afflicted with illness, he is carried into the lock, and the air pressure there is brought up to that of the tunnel. In most cases this is sufficient to revive the sufferer, and the air is gradually allowed to decompress, this operation taking from half an hour to three-quarters, as the case may seem to demand. In the event of a serious attack, where the services of a doctor are required, the patient is carried into the inner compartment and an air-tight door closed, so that the doctor, on his arrival, may enter the outer chamber, where the air is compressed to

the extent of that in which the sufferer has been placed, and the doctor can then enter without the risk of disturbing the atmosphere of the inner chamber. The medical air-lock has not yet been required at Aberdeen, and those in charge are hopeful that it will not be called into use. One other provision for the comfort of the miners is worthy of note. The temperature of the tunnel is considerably higher than that of the outside atmosphere, and in order that the men may not have to run the risk of a chill on emerging, a bothy has been erected, and here the men sit around a comfortable fire and cool down before leaving for home.

In many respects the operations are of a most interesting kind, and their successful accomplishment requires a great amount of forethought and skill on the part of the resident engineer and of Mr. Tawse, the contractor. Thus far the work has progressed in a highly satisfactory manner, and there is no reason to fear that any difficulties that may yet be met with will not be successfully overcome.

COMMUNICATIONS.

Under this heading will be published inquiries addressed to the Editor of COMPRESSED AIR. We wish to encourage our readers in the practice of making inquiries and expressing opinions.

We request that the rules governing such correspondence will be observed, viz.: all communications should be written on one side of the paper only; they should be short and to the point.

MAXFIELD MINE,
ARGENTA, VIA SANDY, UTAH,
March 22, 1905.

COMPRESSED AIR,
New York City, N. Y.:

GENTLEMEN—I must congratulate you on your monthly publication, COMPRESSED AIR. It gives all the information pertaining to up-to-date devices and inventions in which compressed air is used, besides keeping the practical man, engineer, contractor, mine owner or any one interested in its use, informed on the subject. I have sent Vol. IX. to the binders and consider it very valuable for reference. I cannot say too much for the information I have already received from it and wish you all success. I remain,

Yours truly,
ARTHUR D. ADAMS,
Engineer in Charge.

NEW YORK, January 18, 1905.

COMPRESSED AIR,
New York City:

GENTLEMEN—I have just received a letter from a prominent publication, copy of which I inclose, suppressing the name. I should be glad to receive your comment on the above should you choose to favor me.

Truly yours,
E. A. W. JEFFERIES.

January 18, 1905.

Mr. E. A. W. JEFFERIES,
New York City:

DEAR SIR—Your favor of the 28th ult. is received.

In regard to the statement in a recent number of our periodical, referring to compressed air— "that if used at the temperature of compression, the loss may be 50 per cent."—we would say that the losses referred to included all of the friction and mechanical losses, as well as the theoretical losses due to imperfect expansion and leakage by valves and pistons. In other words, in good commercial practice you may hope to get in useful work from a compressed air plant about 50 per cent. of the energy that is used in compressing the air, providing the compressed air is used at the temperature of compression. Under favorable circumstances somewhat higher efficiencies are obtained, but the percentage mentioned is a conservative average figure.

If the air is cooled during the process of compression, or after compression, the efficiency will be reduced correspondingly to an amount depending on the degrees of cooling.

The energy of any gas *per unit* of volume at a given pressure is entirely independent of the temperature. A cubic foot of gas at 0° F. and any given pressure will have the same energy as a cubic foot of gas at any other temperature, such as 460° F. at the same pressure. There will, however, be a smaller weight or less quantity of gas in the cubic foot at the higher temperature.

Faithfully yours,

The loss is given at 50 per cent. "if the air is used at the temperature of compression." This seems to assume that the air is compressed adiabatically, *i. e.*, with no

loss of heat. The case will best be considered by a subdivision into the processes of compression and expansion, assuming no loss of heat at any stage.

Let a volume V of air at temperature T and pressure P be compressed adiabatically to volume V′, pressure P′ and temperatures T″. The relations of pressure and temperatures will then be thus:

$$T''/T=(P'/P)^{.29}$$

Now let this volume of air be expanded adiabatically from pressure P′ and temperature T″, to pressure P′ and temperature T′. The relations are then,

$$T/T'=(P'/P)^{.29}$$

Equating these values.

$$T''/T=T/T'$$

From which

$$T''—T : T—T''=T'' : T$$

In other words, the ratio of the range of pressures in compresion, T″—T, to the range in expansion, T—T′, is equal to the ratio of the higher absolute temperatures T″ for compression and T for expansion. And the loss of efficiency due to the fall of temperature in expansion is the proportion which this fall, T″—T, bears to the maximum temperature T″.

The meaning of this in practice is best shown by two examples.

Case 1. Let P=14.7 lbs. abs.
P′=94.7 lbs. abs. 80 lbs. gauge.
T 60° Fahr. 522° abs.
T″ 433° Fahr. 894° abs.
T′ 60° Fahr. 522° abs.

Since the loss of efficiency T″—T/T″ we have

Loss of efficiency 894°—522°/894° 41.6 per cent.
Efficiency 100—41.6 58.4 per cent.

Case 2. Let P 14.7 abs.
P′ 114.7 lbs. abs. 100 lbs. gauge.
T 60° Fahr. 522° abs.
T″ 484° Fahr. 946° abs.
T′ 60° Fahr. 522° abs.

Loss of efficiency 946°—522°/946° 44.8 per cent.
Efficiency 100—44.8 55.2 per cent.

It thus appears that the efficiency of performance in compression and expansion under these conditions diminishes as the pressure increases. If we assume the mechanical efficiency of the compressor and motor at 90 per cent. and of the transmission system between at 95 per cent., we have a total mechanical efficiency of about 77 per cent. And the resultant efficiencies in the two cases are as follows:

Case 1. 80 lbs.—.584 x .77 44.9 per cent.

Case 2. 100 lbs.—.552 x .77 42.5 per cent.

The fallacy in the above, for practical purposes, is that in practice the air is *not* used adiabatically. The use of jackets and intercooler brings the compression curve nearer the isothermal than the adiabatic and the efficiency of compression is correspondingly increased. While the use of reheaters at the motor, by raising the initial temperature of the expansion and increasing the range of expansion, increases enormously the performance of the engine or motor.

A system of air power distribution made up of high grade two-stage compressors, delivering air through after-coolers and a properly designed transmission system to efficient reheaters, supplying air engines having low clearance and expansion valve gear, will show a net efficiency ranging from 65 to 75 per cent.

The statement is made that "if the air is cooled during the process of compression, or after compression, the efficiency will be reduced corresponding to an amount depending upon the degree of cooling." This statement is incorrect—cooling during compression increases the efficiency instead of diminishing it. This is the object of water-jacketed cylinders and multistage compressors with intercoolers; they combine to reduce the power required in compression. After-cooling has its distinct advantages in precipitating moisture before the pipes are reached, thus avoiding freezing, obstruction and bursting of air pipe lines. It also prevents freezing at motor exhaust ports if the air for any reason is applied in these motors without heating.

The energy of air per unit of volume at a given pressure is, as stated, entirely independent of the temperature. This statement is evidently intended as an argument against reheating. But heating a cubic foot of air, in confinement, produces an increased pressure and a corresponding increase in the available energy. While if the air is not confined, its volume is increased by reheating while the pressure remains the same; the result still being an increase in the available energy.—EDITOR.

Notes.

Proposals for 10,000 barrels of Portland cement were received by the purchasing agent of the Isthmian Canal Commission, at Washington, D. C., April 13, 1905.

The Simplon Tunnel was formally opened April 2, when two trains, one starting from each end, met at the centre. The meeting was made the occasion for great rejoicing.

The Rochester Portable Compressed Air House Cleaning Company has been incorporated under the laws of New York State, with a capital of $3,000. The incorporators were G. K. Baldwin, H. M. Matteson, A. de Young, all of Rochester, N. Y.

Articles of incorporation have been filed at Washington, D. C., by the Richmond Compressed Air Cleaning Corporation, with a capital of $7,000. The incorporators were E. Quincy Smith, Jackson H. Ralston, John B. Sleman, Jr.; Lee D. Latimer and Charles B. Fitzwilson.

The Dayton Pneumatic Tool Co. has been incorporated in Ohio with a capital of $50,000 for the purpose of manufacturing pneumatic tools and all kinds of air appliances. This company has taken over the business of the Chicago Tool and Supply Co., and will manufacture the "Green" pneumatic hammers in its own factory at Dayton, Ohio, where the principal offices will also be located.

The Pilling Air Engine Company has been organized under the State laws of Michigan, with a capital of $25,000. The officers are J. C. Fleming, president; F. L. Bromley, secretary and treasurer, and J. L. Pilling, vice-president and general manager.

This company has under construction at Detroit, Mich., a factory of 5,000 square feet floor space, and will manufacture portable hoists and stationary compressed air engines.

"Modern Gas Engines and Producer Gas Plants" is the title of a book by R. E. Mathot, M. E., which has just been published by the Norman W. Henley Publishing Co. of New York. It is really a guide for the gas engine designer, user and engineer, and it deals with the construction, selection, installation, operation and maintenance of gas engines. Gas engines are coming more and more into service for operating air compressors and the pneumatic engineer will be wise to familiarize himself with that form of power generator.

A pneumatic sheet pile driver was used very effectively in building the foundations for the Hotel Albert, as described in the *Engineering Record* for March 11, 1905. This pile driver consists essentially of a pneumatic cylinder controlled by a piston valve. The hammer is forged in one piece with the main piston and its rod. It strikes upon a free follower contained in the forked casting which embraces the pile and supports the cylinder. The hammer strikes, at a maximum, 500 blows per minute. In this work air was furnished by a Rand compressor.

The *Railway Journal* for April, 1905, illustrates and describes a pneumatic smith hammer made by Mr. W. J. Shea, mastersmith of the Illinois Central Railroad at McComb, Miss., for straightening round or flat iron in scrap pile. This hammer was made of an 8-inch brake cylinder cast-iron block for the anvil and the upright frame is an old mortising machine which had been scraped from the car shops. The device is operated by a foot treadle connected with the valve on top of the cylinder by a rod, which leaves both hands of the operator free to handle his work.

Compressed air motors are successfully employed in mine haulage at a number of places. At the Red Point Mine, Placer County, Cal., the power is derived from the water flowing from the mine, which is collected and carried to a water wheel, which it operates under 600-foot head. The air pressure in the motor receiver, when freshly charged, is 700 pounds per square inch. This is sufficient to supply power to the motor to take the train into the mine on an upgrade. On coming out loaded, the train is controlled by brakes of the ordinary type, operated by hand. Originally these brakes were controlled by compressed air, but it required about as much air to brake a train out as it did to haul one in by means of the motor, and the practice was discontinued. — *Mining and Scientific Press.*

A recent issue of the *Iron Age* illustrates a novel service for a pneumatic sand rammer. It was used for filing slots in armatures. A 1¼ x 7 inch rammer was selected because of its length of stroke and lightness. The rammer is pivoted in an extra head, which is mounted on the bed plate of the lathe, and is so balanced that with the file inserted it will feed into the slots of its own weight. The armature to be filed is supported on the lathe centres, so that it may be readily revolved. The rapid reciprocating motion of the rammer and the fact that it is held accurately in alignment permits the rapid filing of armatures, it being estimated that one machine of this kind will do as much work as five men working by hand, and that the character of work done is free from such irregularities as are necessarily associated with hand work.

Varied uses are found for compressed air at the Beaver Movable Dam, as described in the *Engineering Record* of March 11, 1905, by W. H. Chadbourn, Jr., M. Am. Soc. C. E., Asst. U. S. Engineer. Regarding it he says: "The power-house is a handsome brick and stone-trimmed structure with a tower which contains a water tank. A Heine water-tube boiler furnishes the power to operate the lock. An air compressor furnishes the air to assist in operating the bear-trap weirs, to operate the 32 filling and emptying valves in the river wall, and for an air lift to elevate water to the tank. At present the gate engines are operated by seam transmitted from the power-house; but as there is much trouble from condensed steam, the air compressor plant will be increased and the gate engines operated with compressed air. In the power-house there is also a small machine shop, a blacksmith shop, and a small office for the lockmaster."

The last official act of the Panama Canal Commission before resigning was to close a contract with the Ingersoll-Sergeant Drill Company, of New York, for 50 standard rock drills of that company's manufacture, complete with mountings and equipment. These machines are to be used in the removal of rock in the great Culebra Cut through the crest of the Isthmus. The Commission furthermore authorized the same company to remodel a large number of the French-Ingersoll drills, built in France under the patents of the American manufacturers. These machines remain from the original equipment of the old French Company formerly operating on the canal. This act of the Commission is interesting as showing the intention of using American machines and American methods in this, the greatest undertaking in the history of rock excavation. While the fact that the old drills are still in a condition to justify their use shows the superior merit of machinery of American type and design.

Mr. J. W. Duntley, President of the Chicago Pneumatic Tool Co., sailed on the 18th instant on the Kaiser Wilhelm II. for a five weeks' trip to Europe, in the interests of the pneumatic tool business, taking with him five styles and sizes of electric drills for which the trade of the Consolidated Pneumatic Tool Co. have been clamoring, and important tests and orders are awaiting Mr. Duntley's arrival, for the purpose of having him demonstrate these tools before the orders are placed with others, as was contemplated previous to the announcement of his expected trip, and he has every reason to believe he will succeed in securing this business. A large volume of business is expected to result from this trip. Business with the Chicago Pneumatic Tool Co. is the best in its history, as to the number of tools sold, etc. The month of March last was the best month since May, 1903, and April up to and including the 18th shows an increase in the number of tools sold, of 49 per cent. over the month of March (corresponding days), and an increase of 22 per cent. over the first 18 days of April, 1904. The foreign business has also increased considerably, but while not in proportion to domestic business it is yet very encouraging, and would seem to indicate that the year will be the best in the history of the pneumatic tool business. In view of the fact that the resumption of business has been grandual, and has not affected the metal trades as a whole, should a general activity take place, the sale of pneumatic tools and appliances would undoubtedly be phenomenal.

In view of some of the fears that were expressed by some conservative managers as to the working of the storage air brake system on a large scale, it is gratifying to

learn of the small amount of difficulty that has been experienced in the practical operation of this system at St. Louis during the cold weather. The difficulties so far encountered are strikingly similar to some of the small difficulties met in the early days of air brake apparatus supplied from individual compressors on each car. One of the things which must be guarded against in piping the car, whether for a storage air brake system or for an individual compressor system, is to avoid as far as possible all places where water will have a chance to collect and freeze so as to obstruct the action of the brakes in cold weather. That a certain amount of moisture will collect in compressed air apparatus is inevitable. The important thing is to see that it gathers where it can be drained off, and, further, to see that it is removed at frequent intervals. In the storage air brake system the reducing valve seemed to have been the first point of attack of Jack Frost, and it may be advisable in future installations to put this valve inside the car. In the individual compressor system it was early found that pockets where moisture could collect in pipes without a chance to drain off were to be avoided.—*Street Railway Journal.*

In the April number of *Machinery* is published a letter from Mr. A. E. Mitchell, of Malone, N. Y., on the use of compressed air as an aid to a fan blast in a forge shop. Mr. Mitchell writes:

"During an extra rush of work in the blacksmith shop, caused by engine failures and snow blockade, something extra in the way of noise was heard in the fan corner. The engine was stopped and an examination showed that every blade of the fan was broken off close to the hub. A new fan on short notice was out of the question, but the difficulty was quicker overcome by calling in the pipe gang and piping the forges for compressed air. The fan conduits were laid in the ground and connected to the forges with 2-inch pipe. These pipes were disconnected and taken to the drill-press and holes for ¼-inch pipe drilled in them. The ends of some short pieces of ¼-inch pipe were plugged and 1-16-inch holes were drilled through the plugs. One of these short pieces was thus inserted in each 2-inch pipe and connected to the air mains with a 1¼-inch valve convenient to the blacksmith's hand. By leaving the slide valve in the fan pipe open, the velocity of the jet of air draws quite a volume of air through the fan conduit, giving a good soft blast.

"After fan was repaired the air system was left intact, and the following are a few of the good points of this system. If the fan belts break or run off, or if the engine slows down, because of an extra heavy load, thus making the fan blast insufficient, or if the engine is stopped for any cause for a few minutes, the blacksmiths have only to open the air valves and go on with their heats. It is also convenient for round-house work, nights and Sundays, as the air supply is independent of the engine and the shafting need not be run for short jobs."

The *Engineer* (English) describes a small portable, electrically-driven air compressor, designed and put on the market by Messrs. Lacy, Hulbert & Co., of 25 Victoria street, Westminster, for use in electric power stations and electric tramway sheds.

It has long been recognized, says the *Engineer*, that a jet of air is an excellent means of keeping parts of electrical machinery, otherwise not-get-at-able, free from dust and dirt. The compressor under discussion is claimed to produce such a jet of air in a highly efficient manner, and moreover to be small, compact and silent in working. The compressor gearing and motor are mounted on a base which also acts as a receiver. The whole is carried on traveling wheels and a castor, so that the machine may readily be moved about from place to place. The compressor itself consists of two cylinders placed in alignment, and fitted with trunk pistons connected to a single throw crank shaft. The pistons and cylinder covers are each fitted with valves, which are so constructed that at the end of each stroke they practically engage with one another, and the clearance allowed for is only just sufficient to prevent the piston from striking the cylinder cover.

In action the air drawn from the atmosphere passes through a filtering box into the crank chamber and cylinder, and is discharged through the covers into the receiver underneath the compressor. The gearing is epicycloidal, which permits of the compressor and motor shafts being in one straight line. This arrangement entirely prevents undue lateral pressure

on the motor bearing, the torque being transmitted to the compressor shaft as a couple and not as a single turning moment. The absence of vibration and silent running are claimed to be notable features of the machine, and the system of lubrication is stated to be so effective and tidy that no oil runs to waste or is thrown about.

A recent speaker before a State electric railway convention advocated the idea that the air storage reservoir pressure carried on an ordinary interurban car should not be greater than the air pressure which could be applied in the brake cylinder without skidding the wheels. In other words, according to this theory, it would be possible for a motorman to apply the full pressure available to the brakes by throwing the motorman's valve wide open between the storage reservoir and the brake cylinder without skidding the wheels. This, we believe, is not true in ordinary practice, as the storage reservoir pressure is usually very much more than could be applied to the brake cylinder without skidding the wheels. By thus carrying such a high pressure in the large reservoir much larger storage capacity can be secured with a given size of storage tank. It must be admitted that, from an operating standpoint, it would be desirable not to carry a greater pressure than would skid the wheels, because, if the storage pressure was kept down to this amount, there would be less opportunity for a rattled motorman to put too much pressure into the brake cylinder in making an emergency stop, and by skidding the wheels, greatly increase the distance at which the car could be stopped. Until, however, companies are willing to put on additional storage capacity, or to introduce auxiliary tanks with reducing valves between the main storage tanks and the auxiliary tanks, the reservoir pressure on interurban cars equipped with motor compressors is likely to be carried considerably above the skidding pressure. In steam railroad practice with automatic air brakes it is absolutely necessary to limit the maximum pressure that can be applied in the brake cylinders. In interurban railway practice with straight air brakes on a car under the direct control of the motorman, it is not as necessary to limit the pressure, as any experienced motorman can tell when the wheels are skidding. Nevertheless, limitation of the possible brake cylinder pressure, even with a straight air brake, on an interurban car, is desirable, and if it can be accomplished without too much complication, it is worth some consideration by operating and manufacturing companies. — *Street Railway Journal.*

A remarkable compressed air accident occurred on March 27, at the Joralemon street end of the tunnel now being constructed under the East River for connecting the New York and Brooklyn subways. At the Brooklyn end the advance shield had reached a point about 200 feet from the shore shaft and about 75 feet riverward from the bulkhead line. At this point there was only about 5 feet of covering over the roof of the tunnel, and about 15 feet of water. The first lock was located about under the wharf line, and the shield was some distance in advance, and in front of the shield excavation had progressed under an apron dividing this compartment about midway horizontally. In this forward compartment eight men were working at the time of the accident under the leadership of Richard Creegan, an expert tunnelman. Just as this gang commenced work a leak began to show itself in the roof, where the compressed air was escaping, and Creegan attempted to close it with the hay bags provided for this purpose. As Creegan lifted a second bag to the leak there was an upward rush of air, and in a moment his companions saw only his feet hanging from a hole in the roof; then his feet disappeared, and he was shot bodily upward by the force of the escaping air, pushed through the 5 feet of mud and the water above it to the surface. He was rescued by some longshoremen, and really suffered no physical harm as the result of his terrible experience. The escape of Creegan's fellow workmen was no less remarkable. According to all precedent the inrush of mud and water through the roof should have caught them like rats in a trap. The air pressure in the forward compartment was about 16 pounds to the square inch, corresponding to a depth of about 40 feet. But Creegan's body plugged the hole for a very short time and practically stopped the movement in the mud, and when he was blown through the air escaped with him and the air pressure in the compartment was reduced about to the normal atmospheric pressure, stopping for the time any out-

ward rush of air and permitting the mud to settle back in the hole. This momentary plugging of the hole enabled the men to escape through the shield into the compartment beyond, which was still under full air pressure. The shield was in nowise damaged, and with perhaps some artificial thickening of the roof section the work will progress as before.—*Engineering News.*

The fifth annual session of the Summer School for Artisans, held under the direction of the College of Engineering of the University of Wisconsin, begins June 26 and continues for a period of six weeks.

Courses of study are offered in the following subjects:

1. *Engines and Boilers.*—Lectures and laboratory courses covering the theory, construction, management and testing of steam engines, boilers, gas engines, refrigerating machines, etc.

2. *Applied Electricity.*—Lectures and laboratory courses covering the theory of direct and alternating current dynamos and motors, the operation and method of testing electrical machinery, batteries, transformers and other apparatus, photometry and calibration of instruments.

3. *Mechanical Drawing and Machine Design.*—Elements of applied mathematics, courses in mechanical drawing and machine design adapted to the preparation of the students.

4. *Materials of Construction, Fuels and Lubricants.*—Lectures on the properties of materials, accompanied by laboratory tests; lectures on fuels and lubricants, with laboratory tests on the heating value of coals and efficiency of lubricants.

5. *Shop Work.*—Practice with hand tools, wood and metal working machinery, and in blacksmithing and pattern making.

The instructional force is taken from the regular faculty of the College of Engineering, and the entire laboratory and shop equipment belonging to the college is used by the students in the summer school.

The requirements for admission do not extend beyond a working knowledge of English and arithmetic, but the policy is to allow a large amount of individual work, so that the student may take advantage of all the preparation he has obtained.

This school offers to those unable to take a regular four years' course an opportunity of obtaining a working knowledge of the methods of testing and the use of instruments, together with such theoretical principles in each case as the nature of the subject and the preparation of the student may permit.

Correspondence students have found this school of value in giving an opportunity for laboratory practice along the lines in which they have had theoretical instruction.

A bulletin describing the work of the School for Artisans in detail will be sent on application to Frederick E. Turneaure, Dean, College of Engineering, Madison, Wis.

Diamond drilling as a means of locating the gold-bearing reefs of the Transvaal, has been in general practice for many years. Unusual interest attaches to it at the present time owing to the large number of deep holes which are being sunk to prove the existence and position of the ore bodies at increasing distances from the outcrop. For this work larger and larger drills have been used and within the past year or two numerous bore holes have been bottomed in ore at depths of from 4,500 to 5,000 feet.

Upward of 300 diamond drills are now in use in South Africa, the prevailing types being the Sullivan and Pullock, manufactured by the Sullivan Machinery Company, of Chicago. For the deep holes referred to the favorite drill is the Sullivan improved Class "P," rated capacity 4,000 feet. The mining companies as a rule let the work to contractors, who furnish all the equipment and expert operators, and deliver the core into the hands of the company. American contractors have recently broken all records for depth. James Tobin completed a bore hole last December, at Doornkloof, sixteen miles west of Randfontein, at a depth of 5,560 feet. This hole was sunk to prove the main reef series, and it is understood that the results are conclusive although they have not been made public. The deflection was very slight. The first 3,200 feet were bored with a Sullivan size "N" drill, rated capacity 2,000 feet; a size "P" drill of latest improved pattern with rated capacity of 4,000 feet, was then put in commission and continued the hole until its completion at 5,560 feet. 700 feet of size "N" rods removing 2-inch core were used, the remaining 4,860 feet being B,

removing a 1⅜-inch core. The total load of these rods was between 15 and 16 tons, which was handled by the engine without difficulty. The actual running time of this hole was 14 months, or an average of nearly 400 feet per month. For the first two months two ten-hour shifts were used and for the balance of the time the work was carried on the whole 24 hours, divided into three eight-hour shifts. The rods were pulled in lengths of 50 feet, the height of the tubular steel derrick being 66 feet over all. The time required to lower the rods at a depth of 5,000 feet was from 3 to 3½ hours and from 3½ to 4 hours was required to lift them.

This record has since been bettered by a hole sunk near Springs, east of Johannesburg, by John Skenke. This hole was begun May 1, 1904, and completed Feb. 2, 1905, at a depth of 5,582 feet. A size "P" drill was also used here, power being supplied by a 30 I. H. P. boiler. 1,000 feet of "N" (2-inch core) rods were used, the remainder of the equipment being similar to that used by Tobin.

The water supply of Los Angeles, Cal., has in the past been received by gravity, only a few higher parts of the city being supplied by pumping into the mains. The growth of the city, however, has made an additional supply necessary, and a pumping plant is to be installed in the southwestern part of the city, near Slauson Junction, where wells have been bored to water bearing strata lying 60 to 200 feet below the surface. As these wells are too deep to be operated by pumping engines located on the surface, and as it would be commercially impracticable to pump them by deep well pumps with long plunger rods, and, again, very costly to excavate pumping stations underground near the water level, it has been decided to use compressed air, which offers the further advantage that one central plant may operate all the wells scattered over a half-mile stretch.

The system adopted is the air lift, in which compressed air is forced to the bottom of the well through one pipe, where it discharges under the mouth of another reaching to the top of the well and emptying into the reservoir. The bubbles of air issuing from the first pipe enter the mouth of the second carrying the water between them. The water within the second pipe being mixed with air weighs less than that in an equal cross section of the well exterior to the pipe. The pressure of the water in the well therefore is greater and forces the mixture of air and water in the pipe to rise constantly, and as the bubbles of air are continually supplied at the bottom this process goes on continuously, the mixture of air and water discharging at the top of the well in a practically constant stream. The air as it rises toward the top expands, thereby returning the work which was expended in its compression, and as in expansion the temperature of air is greatly reduced it serves at the same time to cool the water.

In the present case the 12 wells will discharge into a common reservoir, from which the water will be forced by a pumping engine into the city water mains. The water in the wells at present stands about 60 feet below the surface, but, as has been found in irrigation work in California, the ground level of subterranean water supplies is apt to be lowered considerably by continuous pumping and the compressor has therefore been designed to pump, if necessary, from a much lower level, being guaranteed to deliver 2,000 cubic feet of air per minute against a pressure of 100 pounds. The contract for the compressor was awarded to the Baker Iron Works, Los Angeles, who are local agents of the Laidlaw-Dunn-Gordon Company, New York City. The compressor is of the two-stage type, in which the air is partly compressed in a large cylinder, passed through a cooler and further compressed in a high pressure cylinder. The steam engine driving the compressor and forming a part of it is also compounded.

On the 22d ult. a lecture was delivered by Mr. H. Stanley Allen on "Experimental Work at Low Temperatures," before the members of the Royal Philosophical Society, Glasgow, March 22. The lecture had reference mainly to the work of research in low temperatures being carried out in the private laboratory of Lord Blythswood, at Blythswood House, Renfrewshire. The plant, which had recently been set up there for this very special line of research, comprised apparatus for the production of liquid air and also of liquid hydrogen. The essential features of the liquid air apparatus were a Whitehead torpedo compressor and a Hampson liquefier.

The compressor, which required 6 horsepower to drive it, compressed the air to 200 atmospheres—some 3,000 pounds per square inch. In the Hampson liquefier, by the application of principles investigated fifty years ago by Joule and Kelvin, intense cold was produced by the sudden expansion of the compressed air. This apparatus was capable of producing a litre and a half—nearly three pints—of liquid air in an hour. The temperature attained was about 200 degrees below zero on the Centigrade scale. The production of liquid hydrogen was a more difficult matter. The first step was the preparation of pure hydrogen on a large scale. Hydrogen did not assume the liquid state until its temperature was 50 degrees below the temperature of liquid air. The nearer the "absolute zero" of temperature was approached the more difficult did further progress become. The apparatus of the Blythswood laboratory for liquefying hydrogen was designed by Dr. Morris Travers. Under his direction liquid hydrogen was produced for the first time in Scotland on January 14 last. At the excessively low temperature of liquid hydrogen all known gases were liquefied with the exception of helium. Ordinary air was frozen to a transparent solid, which could be broken by a blow from a hammer.

Although the production of these liquefied gases had not as yet proved of commercial value, it had been of the greatest importance in scientific research. Practical results in the past had depended on abstract investigations. Discoveries, apparently the most remote and unpromising, had resulted in the most important practical issues. Special interest attached to the application of liquid air in the production of high vacua. Professor Sir James Dewar had shown that charcoal at the temperature of liquid air was capable of absorbing large volumes of gas. A glass bulb containing charcoal, cooled to this low temperature, could absorb practically all the air in a second larger bulb in communication with it. By this method an X-ray bulb 5 inches in diameter had been exhausted at the Blythswood laboratory in an hour and a quarter. By the method usually employed the exhaustion would take several hours. The lecture was illustrated by a number of experiments with liquid air, and Dewar's method of exhausting a vacuum tube was shown in operation.—*The Engineer* (Eng.).

Many European novelties have been booked to make their American debut at the Proctor houses; among the most important of them is Dida, which is described as the creation of a woman out of nothing, and which is really one of the most wonderful illusions of the present day. Another act of much interest is Co-Co, the mimetic monkey, one of the cleverest and best trained simians ever shown in public.

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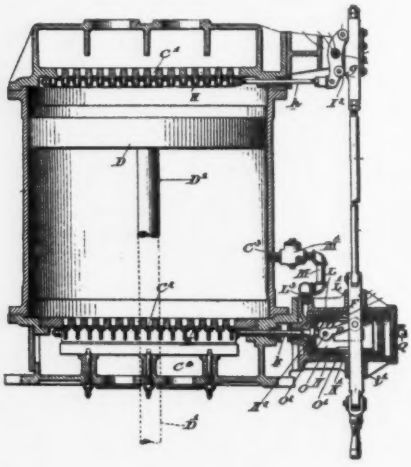
U.S. PATENTS GRANTED MAR., 1905.

Specially prepared for COMPRESSED AIR.

784,122. BLOWING-ENGINE OR COMPRESSOR. Gustav B. Petsche, Philadelphia, Pa., assignor to The Southwark Foundry & Machine Company, Philadelphia, Pa., a Corporation of Pennsylvania. Filed Apr. 20, 1903. Serial No. 153,450.

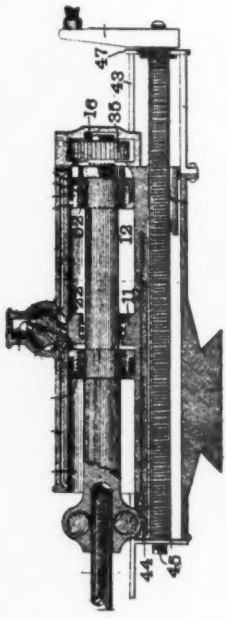


A blowing engine, the combination of a delivery-valve with means acting to open said valve when the pressures in the compressing cylinder and receiver are substantially equal, a reciprocating device positively actuated by a moving part of the engine, another reciprocating device acting when moved in one direction to close the valve and when moved in the other direction to leave it free to open, said device moving in a path substantially at right angles to that of the positively-actuated device aforesaid and a link connected with the valve-closing device and connected also to a point on the positively-actuated device which moves alternately above and below the link's point of connection with the valve-closing device.

784,166. PNEUMATIC TIRE. Ernest Large, Toronto, Canada. Filed Mar. 12, 1904. Serial No. 197,820.

784,185. AIR-SEPARATOR AND WATER-SEAL FITTING. Samuel V. Sharood, Brockton, Mass., assignor of one-half to Lucius R. Churchill, Brockton, Mass. Filed June 23, 1904. Serial No. 213,879.

784,173. ROCK-DRILL. Cyrus T. McCormick, Fredericktown, Mo. Filed Apr. 11, 1904. Serial No. 202,578.



A drill or the like, the combination with a cylinder provided with a piston and having an open end at one side of said piston, of a piston-rod for and of less diameter than said piston projecting through the open end of said cylinder, and means for exhausting motive fluid from the other side of said piston and discharging it into the side of said cylinder having the open end.

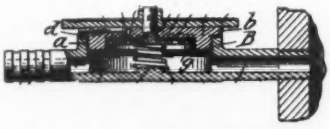
784,204. FLUID-PRESSURE BRAKE. George W. Butcher, San Antonio, Tex. Filed Nov. 3, 1904. Serial No. 231,283.

784,225. PNEUMATIC-DESPATCH APPARATUS. Otto S. Pike, Malden, Mass., assignor to American Pneumatic Service Company, Dover, Del., a Corporation of Delaware. Filed Aug. 6, 1903. Serial No. 168,468.

784,270. PNEUMATIC-CONVEYER SYSTEM. Albert H. Morton, Lowell, Mass. Filed July 13, 1904. Serial No. 216,340.

784,281. PNEUMATIC GRAIN-ELEVATOR. Frank Schacht, Limespring, Iowa. Filed Feb. 17, 1903. Serial No. 143,884.

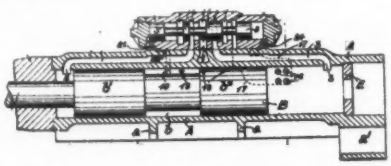
784,228. REGULATING AND INDICATING DEVICE FOR COMPRESSED AIR. Clarence H. Richwood, Boston, Mass. Filed May 17, 1904. Serial No. 208,440.



A device of the character described, a cup-shaped casing having a wall of the opening thereof internally screw-threaded, and having a circular screw-threaded cover engaging in said opening, and having a duct formed within the thickness of the cover and terminating in a port at the inner side thereof, a valve-disk having a series of variably-sized holes in circular arrangement, and adapted according to the rotary adjustment of such disk to register with the aforesaid port, and means for turning the disk.

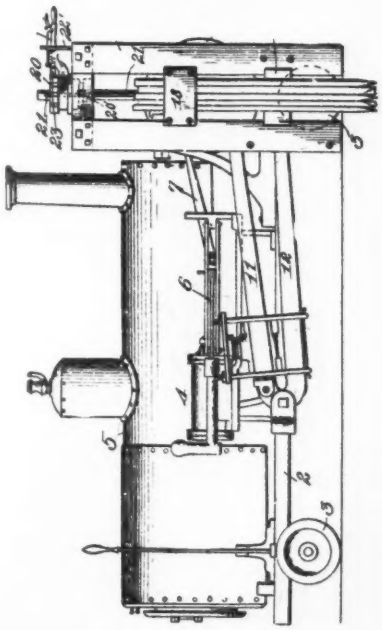
A regulating device for compressed air, the cup-shaped casing provided with an inlet-opening, having the annular wall thereof internally screw-threaded, a circular edgewise-threaded cover screw-engaging in said opening, having a marginal flange overlying the top edge of the casing-wall, provided with a duct formed within the thickness of the cover, terminating inwardly in a port at the inner side of the latter, and said cover being formed at its inner side with a circular cavity, having a disk of rubber or like compressible material provided with an aperture registering with said port, and means for preventing the rubber disk from turning, a valve-disk located within said cavity, and against said rubber disk, provided with a stem extending through a central opening therefor, through the cover, and having a series of variably-sized holes in circular arrangement for registry with the aforesaid port, and a circular plate secured on the outer end of said stem and overlying the cover.

784,320. VALVE FOR ROCK-DRILLING MACHINES. James E. H. Grose, Germiston, Transvaal. Filed Sept. 6, 1904. Serial No. 223,433.



A rock-drilling machine or engine, in combination, the cylinder A and piston B arranged therein, the valve-chest F on the cylinder formed with the ports 9, 10, 11, 12, 13 and 14, the valve 4 arranged in the valve-chest F formed with the pistons 5, 6, 7 and 8, the cylinder being formed with a port 17 and the holes 16 placing said port 17 in communication with the interior of the cylinder said port 17 communicating with the port 14 in the valve-chest, the port 22, groove 23, ports 24 and 23a placing the interior of the cylinder and the main supply-port 1 in communication with the end of the valve-chest, the ports 18 placing the centre portion of the cylinder in communication with the exhaust-port 15, the ports 19, 20, 20a and 21 placing the interior of the cylinder and the main supply-port in communication with the other end of the valve-chest, the ports 19 and 22 being controlled by the piston to alternately close said ports to the exhaust 15 to effect the reversal of the valve 4, substantially as described.

784,268. STONE-CHANNELING MACHINE. Charles M. Lyman, Rutland, Vt. Filed Oct. 11, 1904. Serial No. 228,032.



A stone-channeling machine, the combination of an upper slide having means for clamping a gang of drills thereto, a lower slide, a feed-screw in threaded engagement with the upper slide and swiveled to the lower slide, and a hand-

operable rotary member through which said screw passes, the screw being provided with a longitudinal keyway and said member being provided with a key to fit said keyway.

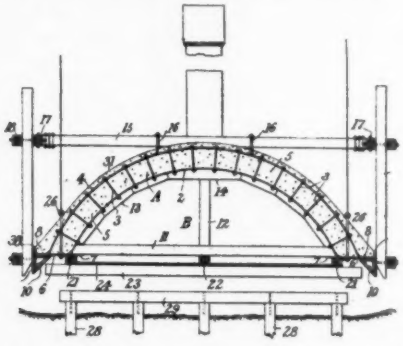
784,321. AIR-BRAKE MECHANISM. Henry E. Haddock, Philadelphia, Pa., assignor to John A. Brill, Philadelphia, Pa. Filed July 21, 1904. Serial No. 217,465.

784,338. PNEUMATIC TOOL. Herman Leineweber, South Chicago, Ill. Filed June 16, 1904. Serial No. 212,765.

A pneumatic tool having a casing carrying at one end the tool and at its opposite end a handle, the combination of the casing having a valve-controlled air-pressure-supply passage, a pressure-chamber in its rear end, an annular pressure-feed groove in its inner wall, between the ends thereof, communicating with said passage, and a circumferential enlargement in said wall back of said groove, a piston reciprocably confined in the casing, having ducts extending longitudinally into it from its rear end and each terminating in a lateral opening in the piston near its opposite end, an enlarged rear end and a reduced section adjacent to said enlarged end co-operating with said circumferential enlargement and forming an abutment therein, and an exhaust-port in the casing common to the pressure from said enlargement and that in said pressure-chamber, substantially as and for the purpose set forth.

784,413. SUBAQUEOUS TUNNEL CONSTRUCTION. Duncan D. McBean, New York, N. Y. Filed Oct. 24, 1904. Serial No. 229,879.

In subaqueous tunnel construction, the method which consists in erecting in place successive, longitudinal sections of the tunnel-roof, driving sheeting side walls outside of and adjacent to the lower edges of the roof, forcing air into the chamber thus formed, excavating the included material, and progressively driving said sheeting as the work of excavation advances.



In tunnel construction, a subaqueous working chamber comprising longitudinal sections of the tunnel-roof anchored in permanent position above the site to be excavated, guides carried by said roof-sections, depending side flanges on said sections, and downwardly-extensible side walls, consisting of sheet-piling slidable in guides upon said roof-sections.

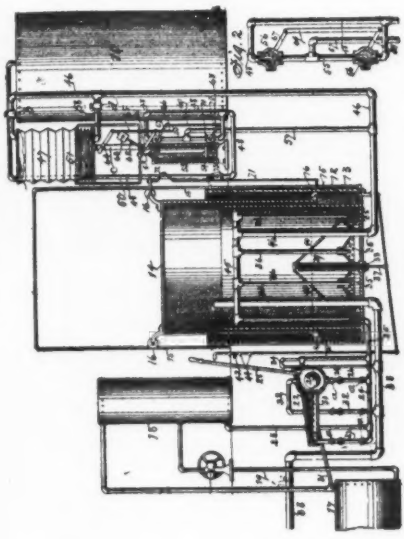
784,489. RAILWAY-BRAKE. Paul Hallot, Vincennes, France. Filed July 7, 1902. Serial No. 114,700.

784,506. AIR-BRAKE SYSTEM. Isaac M. Simons, Youngstown, Ohio. Filed July 19, 1904. Serial No. 217,203.

784,526. AIR-BRAKE APPARATUS. Charles E. Turner, Rochester, N. Y. Filed July 12, 1904. Serial No. 216,236.

784,537. DEFLECTOR FOR AIR-BRAKES. Eugene Bearss, Ellenville, N. Y. Filed Aug. 12, 1904. Serial No. 220,579.

784,575. AIR-PUMPING APPARATUS. Theodor H. J. Leckband, Des Moines, Iowa, assignor to Leckband Gas Company, Mason City, Iowa. Filed July 14, 1902. Serial No. 115,520.



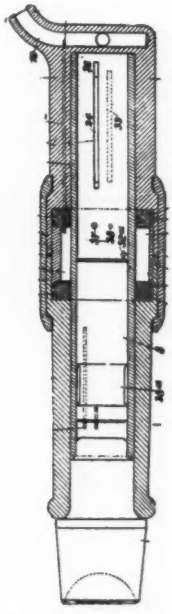
The combination with a carbureter of an air-compressor delivering thereto, a compressed- air motor for driving the compressor and connections whereby the exhaust of the motor is also delivered to the carbureter.

An apparatus for feeding air to a carebureter, an air-forcing mechanism, a reservoir for compressed air, a motor-cylinder having a valve at each end connected with the air-reservoir, a tube connected with each valve for feeding air to the motor-cylinder, a tube connected with each valve for exhausting air from the motor-cylinder, a carbureter, a tube for conveying the exhaust air from both the valves to the carbureter and automatic mechanism for regulating the passage of air from the reservoir to the motor-cylinder, arranged and combined to feed air from the reservoir and from the atmosphere to the carbureter in the manner set forth for the purposes stated.

784,644. PNEUMATIC CONTROL OF DOORS. Charles M. Warner, Memphis, Tenn. Filed Mar. 7, 1904. Serial No. 196,873.

784,910. AIR-BRAKE. Andrew J. Wisner, Philadelphia, Pa. Filed Oct. 3, 1903. Renewed May 14, 1904. Serial No. 207,916.

784,703. PERCUSSIVE HAND-TOOL. Henry Potter, Bromley, England. Filed Dec. 17, 1904. Serial No. 237,307.



The combination, with a cylinder, of a tubular distributing-valve arranged in the said cylinder and prevented from sliding longitudinally therein, said cylinder and valve being provided at one end with ports which are longer than one-half of the stroke of the piston, a piston slidable longitudinally inside the said valve, and means for moving the said valve circumferentially to open and close the said ports.

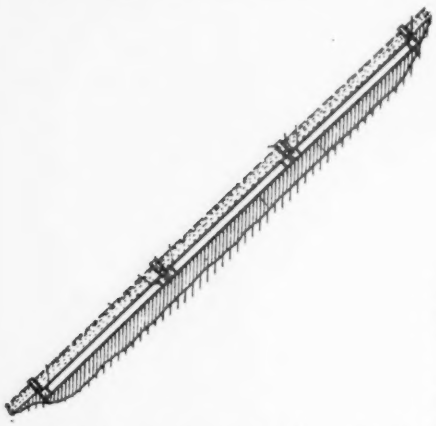
784,738. PNEUMATIC TIRE. Tullio Giara, Boston, Mass. Filed Apr. 19, 1904. Serial No. 203,908.

784,937. PNEUMATIC DISTRIBUTING SYSTEM FOR FLUIDS. Florence M. Griswold, Essex Fells, N. J. Filed Apr. 12, 1904. Serial No. 202,879.

The combination with a service or discharge pipe for a fluid under pressure, of an inclosure for said pipe in which air or other gas is maintained under pressure, a faucet controlling the outlet of the service-pipe and valve ports and passages for establishing connection between the inclosure and the service-pipe when the faucet is closed thus establishing an equalizing pressure

whereby any liquid in the service-pipe may be caused to flow back through the same, as and for the purpose described.

784,816. METHOD OF CONSTRUCTING SUBAQUEOUS TUNNELS. Thomas K. Thomson, Yonkers, N. Y., asignor of one-half to Arthur McMullen, New York, N. Y. Filed Aug. 21, 1902. Serial No. 120,452.



The herein-described method of constructing subaqueous tunnels, which method comprises the construction of a plurality of substantially complete tunnel-sections, erecting on one end of each of said sections a caisson, towing each of said sections to a place above its permanent position, sinking said sections successively, and finally uniting the ends of the adjacent sections within the adjacent caisson, substantially as described.

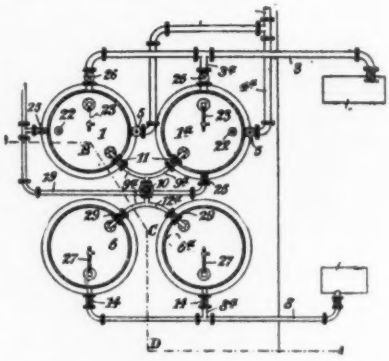
785,015. PNEUMATIC SETTING-MACHINE FOR SAWMILL-CARRIAGES. Alexander H. Masters, Greensboro, N. C. Filed July 29, 1904. Serial No. 218,729.

785,153. MEANS FOR AUTOMATICALLY APPLYING AIR-BRAKES IN DERAILMENTS. Edward S. Coffman, Cliftonforge, Va. Filed Nov. 15, 1904. Serial No. 232,865.

785,154. HAND AIR-PUMP. Gaston E. Cordeau, New York, N. Y. Filed Feb. 17, 1904. Serial No. 194,044.

785,208. RAILWAY SAFETY DEVICE. Freling C. Foster, Chicago, Ill. Filed Oct. 31, 1904. Serial No. 230,675.

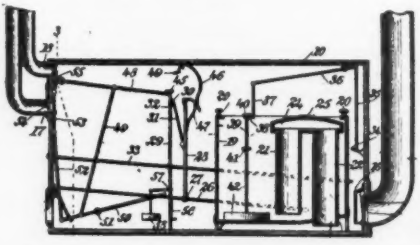
785,307. APPARATUS FOR RAISING LIQUIDS. Gustaw Hantke, Warsaw, Russia. Filed Aug. 11, 1904. Serial No. 220,437.



A plant for raising liquids with the aid of compressed air, the combination with a plurality of liquid vessels, of means for charging said plurality of liquid vessels alternately or simultaneously with liquid, a plurality of storage vessels, means for charging said plurality of storage vessels alternately or simultaneously with compressed air under a varying comparatively high pressure, a pressure-reducing valve, means for arbitrarily conducting the compressed air from either a part or all of said plurality of storage vessels through said pressure-reducing valve to either a part or all of said plurality of liquid vessels, and means for allowing the liquid to pass from either a part or all of said plurality of liquid vessels to the pipe system.

785,420. AIR-BRAKE COUPLING. Jesse J. Grigsby, Milroy, Ind. Filed July 25, 1904. Serial No. 218,072.

785,443. APPARATUS FOR RAISING LIQUIDS. Oscar H. Stakemann, Christiansted, St. Croix Island, Danish West Indies. Filed Oct. 26, 1904. Serial No. 230,105.



The combination with a receptacle for liquid having an air-inlet, of an open-top tank adapted

to float on the liquid, a valve for said inlet, means for automatically opening said valve when the tank sinks and causing it to remain open for a limited period when the tank rests upon the bottom of the receptacle, and means for automatically closing the valve while the tank remains upon the bottom of the receptacle.

A water-raising apparatus, the combination with a water-receptacle having a water-inlet and a water-outlet, of means for conducting compressed air thereto to force water therefrom, a tank in said receptacle adapted to float on the water when empty and to sink when full of water, an air-inlet valve, an air-outlet valve, means for automatically opening the air-inlet valve and closing the air-outlet valve when the tank sinks, means for locking said means while the water in the tank remains above a certain level, means for unlocking said first-named means when the water recedes from said level, and means for then opening the air-outlet valve and closing the air-inlet valve.

The combination with a water-receptacle having an air-valve, of a reciprocable bar, a pivoted lever, means for connecting the valve with the lever for causing motion of the latter to be transmitted to the valve to open or close it, means for causing motion of said bar in one direction to turn the lever about its pivot, means for causing further motion of said bar in the same direction to turn said lever about its pivot in the opposite direction, a float, and connections between the float and the bar for causing the bar to move.

785,468. PNEUMATIC CARRIER. Thomas Bemis, Indianapolis, Ind. Filed Feb. 23, 1905. Serial No. 247,015.

785,513. AIR-BRAKE. Hezekiah Minnick, Laredo, Tex. Filed Sept. 9, 1904. Serial No. 223,864.

785,549. AIR-BRAKE SYSTEM AND EMERGENCY-VALVE. Laurence A. Hawkins, Schenectady, N. Y., assignor to General Electric Company, a Corporation of New York. Filed July 30, 1904. Serial No. 218,882.

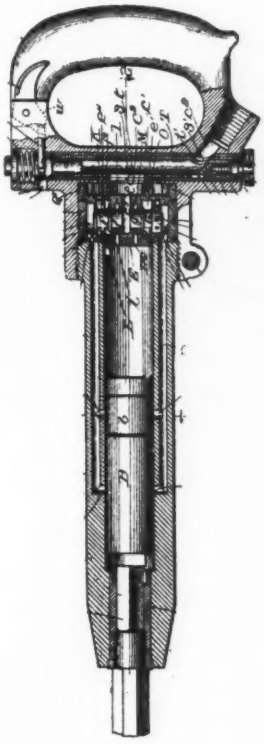
785,811. AIR-SEPARATOR. Charles H. Lane, Cleveland, Ohio. Filed Feb. 29, 1904. Serial No. 195,826.

786,007. AUTOMATIC AIR-BRAKE SYSTEM. Fred B. Corey, Schenectady, N. Y., assignor to General Electric Company, a Corporation of New York. Filed July 21, 1903. Serial No. 166,466.

786,008. AIR-BRAKE CONTROL. Fred B. Corey, Schenectady, N. Y., asignor to General Electric Company, a Corporation of New York. Filed Aug. 13, 1904. Serial No. 220,590.

785,324. PNEUMATIC HAMMER. Reinhold A. Norling, Aurora, Ill., assignor to Aurora Automatic Machinery Company, Aurora, Ill., a Corporation of Illinois. Filed Aug. 19, 1904. Serial No. 221,404.

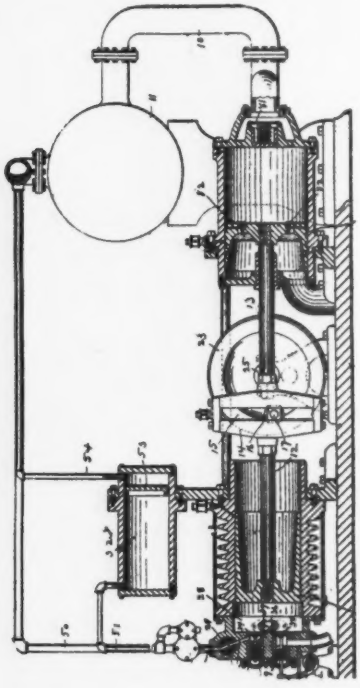
The combination with a barrel and a plunger therein, of a controlling-valve comprising a valve-chamber provided with an air-supply passage and communicating with the inner end of the barrel by two admission-ports and two valve-pistons in said valve-chamber both of which control the admission of air to the inner end of the barrel through said admission-ports, and means for actuating said valve-pistons.



The combination with a barrel and a plunger therein, of a head attached to the inner end of the barrel, a valve-block located within said head in contact with the said inner end of the barrel, said valve-block being provided with a valve-chamber and, in its outer face, with a central air-supply passage and having two admission grooves or recesses located at either side of said central air-supply passage, and a plurality of ports leading from each of said grooves or recesses through the inner face of the block, and two endwise-sliding valve-pistons located in said valve-chamber at the opposite sides of said central air-supply passage and which operate to control the passage of air from said central air-supply passage to the said admission-ports, said valve-block being provided also with two adjacent annular exhaust grooves or recesses one of which communicates with the inner end of the valve-block by a plurality of ports, and the other of which communicates with a space within the head by a plurality of ports, and said valve-block also being provided with an admission

and exhaust groove, connected with the outer end of the barrel, and with an exhaust-groove connected by a port with the space between the valve-block and the head, the valve-piston, which operates in connection with said admission and exhaust groove, being provided with a central passage which opens through its inner end, and with radial openings extending from said central passage through the outer surface of the piston.

785,713. COMPRESSED-AIR AND GAS MOTOR. Merrill E. Clark, Worcester, Mass. Filed Feb. 28, 1899. Serial No. 707,166.



A compressed-air and gas motor, the combination with a motor-cylinder, a corresponding compression-cylinder, and a reservoir in communication with the compression-cylinder, of a fuel-holder, a cut-off-valve chamber and a valve in said chamber, a piston-chamber and a piston therein, the piston connected with the cut-off-valve, the holder and cut-off-valve chamber in communication with the reservoir, a communication between the cut-off-valve chamber and the motor-cylinder, a controlling-valve chamber, communications between the controlling-valve chamber and the piston-chamber and a controlling valve for controlling the said communications.

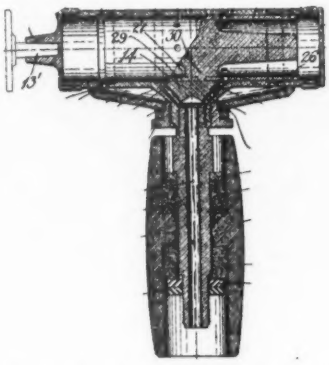
785,889. HYDRAULIC AIR-COMPRESSOR. Clarence R. Jones, Pittsburg, Pa. Filed July 21, 1904. Serial No. 217,471.

A hydraulic air-compressor, a main cylinder, a piston therein, a water-controlling-valve chamber having different diameters, a motor-valve having pistons of different size fitting in the valve-chamber, a primary valve located wholly within the movable motor-valve and at an angle to the axis of the motor-valve, and a stem arranged to actuate the primary valve; substantially as described.

786,075. PNEUMATIC ACTUATING DEVICE FOR THE REVERSING-GEARS OF LOCOMOTIVES. Fred Warther, Canal Dover, Ohio. Filed Aug. 6, 1904. Serial No. 219,772.

A pneumatic actuating device for the reversing-gear of a locomotive, comprising an air-cylinder containing a piston connected with the reversing-gear for actuating the same, a controlling-valve having a valve-casing and a single valve-plug adapted to be turned in the casing by the engineer, pipes connecting the ends of the air-cylinder with the said valve-casing, and a compressed-air supply connected with the said valve-casing, the latter having admitting-ports and exhaust-ports at varying heights thereof, and the valve-plug having connecting-channels at correspondingly varying heights for connecting the proper ports with each other on turning the valve-plug.

786,050. FLUID-ACTUATED VIBRATOR. Clarence H. Richwood, Dorchester, Mass. Filed Sept. 19, 1904. Serial No. 224,951.



A device of the character described, the combination of a cylinder closed at its ends and having air-supply ducts, a piston mounted in the cylinder for reciprocation, means for closing the ducts in the cylinders alternately by the movement of said piston in opposite directions, an exhaust-chamber arranged exterior to the cylinder and having apertures communicating therewith, outlet-ports from the exhaust-chamber, and a screw-plug co-operating with said outlet-ports to vary the opening thereof.

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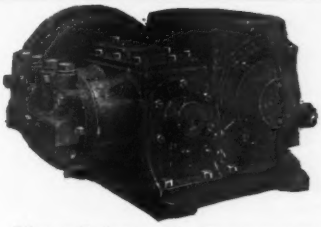

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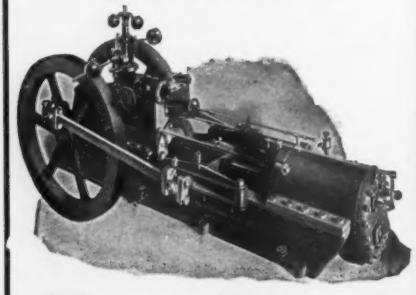

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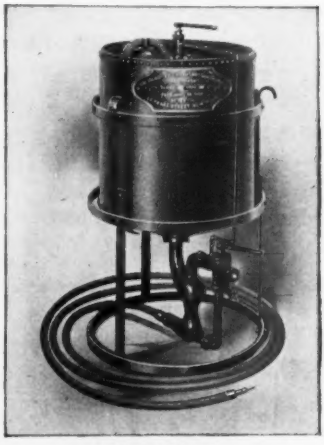

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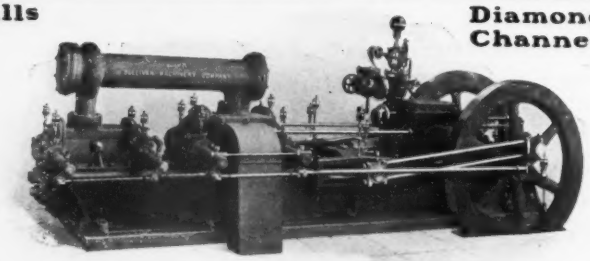

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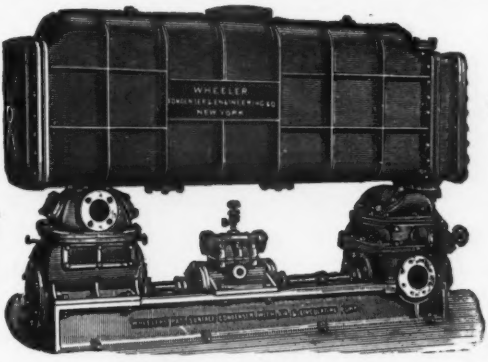

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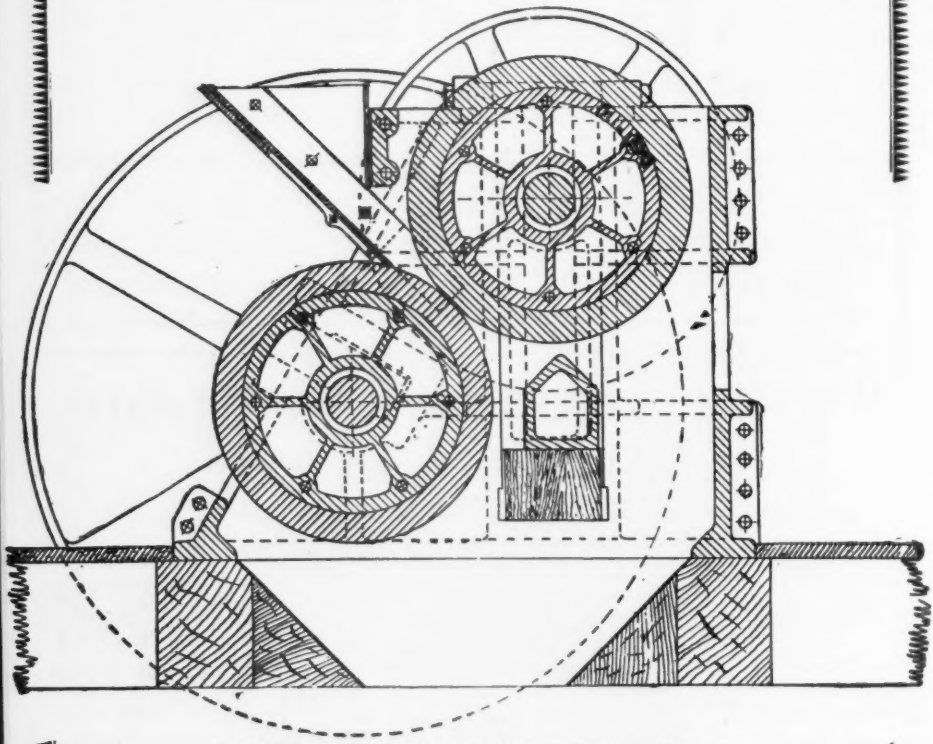

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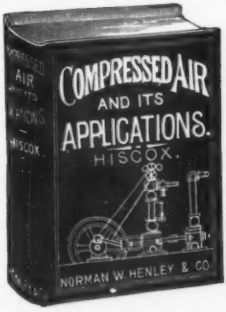

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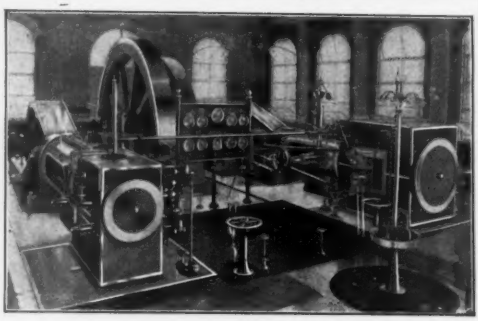

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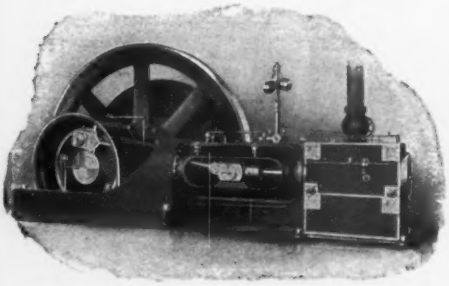

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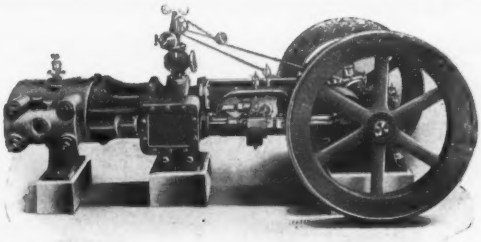

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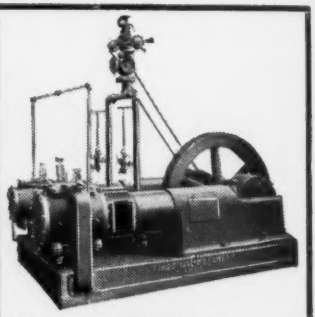

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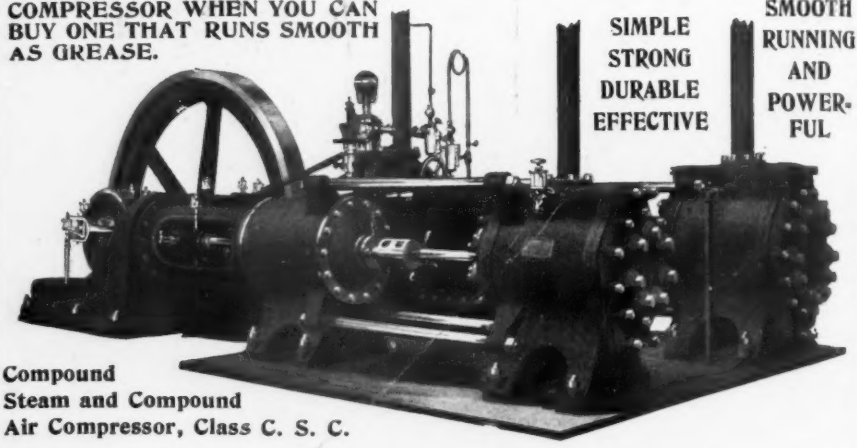

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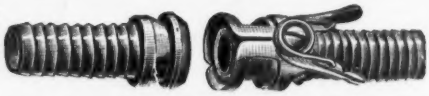

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